POOR

QUALITY

ORIGINAL

MM

FINAL REPORT

TP 4569E

Shared Vehicle Fleet Concepts

State-of-the-Art Review

and

R & D Program Definition

Prepared for:
Transportation Development Centre
Transport Canada

Prepared June 1983 by:

CA1
DTC 820
83
S38
c.2

Jouko A. Parviainen & Associates

33V

TP 4569E

SHARED VEHICLE FLEET CONCEPTS

State-of-the-Art Review
and
R & D Program Definition

Library and Information Centre/
Centre de Documentation (GSLA)
RECEIVED - REÇU LE
SEP 16 1983
Transport Canada Transports Canada

by

Jouko A. Parviainen & Associates
Oakville, Ontario

June 1983

The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre of Transport Canada.

PROJECT TEAM

The project team for Jouko A. Parviainen & Associates was composed of:

Mr. J. A. Parviainen
Dr. J. G. U. Adams

REPORT DOCUMENTATION FORM

1. Transport Canada Report No.	2. TDC Project No.	3. Recipient's Catalogue No.
4569E	4762	

4. Title and Subtitle	5. Report Date
Shared Vehicle Fleet Concepts State-of-the-Art Review and R&D Program Definition	11 June 1983
	6. Performing Organization Report No.
7. Author(s)	8. Transport Canada File No.
Jouko A. Parviainen	D1465-391
9. Performing Organization Name and Address Jouko A. Parviainen & Associates 1125 Linbrook Road Oakville, Ontario Canada L6J 2L3	10. DSS File No.
	11. DSS or Transport Canada Contract No. 4762
12. Sponsoring Agency Name and Address Transportation Development Centre 1000 Sherbrooke Street West Suite 2421 Montreal, Quebec H3A 2R3	13. Type of Report and Period Covered Final, July 82 - June 83
	14. Sponsoring Agency Code
15. Supplementary Notes	16. TDC Project Officer L. Suen

17. Abstract The state-of-the-art review of shared vehicle fleets (SVF), which was based on extensive literature review and discussions with managers of major recent experiments, indicates that past attempts to use SVF as circulation systems in central business districts have failed, and that emphasis is now shifting to residential co-operatives managed by transportation brokers, and other previously untested innovative schemes. The report presents an assessment of factors that must be clearly specified to ensure successful operation of any SVF enterprise (e.g. membership and fleet composition, service definitions, and user charges and agreements).

Based on review of recent socio-economic and travel trends, there appears to be significant theoretical opportunity for implementing SVF schemes in Canada, mainly due to: the economic pressures on households to reduce their transportation expenditures, and the significant time/space flexibilities in current discretionary travel, and the increased flexibilities in all travel resulting from the expected alternative work schedule and communications developments.

However, because of the immense complexity of predicting consumer choices in this intricate attitude/behaviour vs. cost savings trade-off, only the implementation of a carefully designed demonstration program can establish the true propensity of Canadian households to join, and to continue to participate in, SVF enterprises. This report recommends a six-step program for demonstrating the feasibility of implementing SVF operations in Canada.

18. Key Words	19. Distribution Statement
Joint, Shared, Vehicle, Automobile, Ownership	Limited number of copies available from sponsoring agency on request.

20. Security Classification (of this report)	21. Security Classification (of this page)	22. No. of Pages	23. Price
Unclassified	Unclassified	87	NIL

TDC CDT 79-005

FORMULE DE DOCUMENTATION POUR RAPPORT

1. Nº du rapport Transports Canada	2. Nº de l'étude — CDT	3. Nº de catalogue du destinataire
4569E	4762	

4. Titre et sous-titre	5. Date du rapport
Shared Vehicle Fleet Concepts State-of-the-Art Review and R&D Program Definition	11 juillet 1983
	6. Nº du rapport de l'organisme exécutant

7. Auteur(s)	8. Nº de dossier Transports Canada
Jouko A. Parviainen	D1465-391

9. Nom et adresse de l'organisme exécutant	10. Nº de dossier — ASC
Jouko A. Parviainen & Associates 1125 Linbrook Road Oakville, Ontario Canada L6J 2L3	11. Nº de contrat — ASC ou Transports Canada 4762

12. Nom et adresse de l'organisme parrain	13. Genre de rapport et période visée
Centre de développement des transports (CDT) 1000 o, rue Sherbrooke Suite 2421 Montréal, Québec H3A 2R3	final, juillet 82 - juin 83 14. Code de l'organisme parrain

15. Remarques additionnelles	16. Agent de projet — CDT
	L. Suen

17. Résumé Le tour d'horizon sur le concept des parcs de véhicules de co-voiturage, effectué après de vastes recherches documentaires et de nombreuses interviews avec les responsables des divers essais récemment achevés, a mis en évidence l'échec de ce concept utilisé pour la desserte des quartiers d'affaires, et la tendance qui se dessine vers le concept de coopératives prises en charge par des courtiers en transport collectif et vers d'autres projets novateurs non encore éprouvés.

Ce rapport présente les divers facteurs (composition du parc, définition des services fournis, admissibilité, droits et obligations des utilisateurs) qui doivent être pris en compte pour assurer la réussite de toute entreprise de co-voiturage.

D'après les tendances socio-économiques qui se dessinent et la demande de transport constatée, l'occasion serait en principe bonne pour la mise en oeuvre de projets de co-voiturage au Canada, en raison notamment des contraintes économiques poussant les ménages à réduire les dépenses qu'ils consacrent au transport; de la grande souplesse dans l'espace et dans le temps inhérente aux déplacements non obligés et enfin de la souplesse croissante dans les déplacements tous types confondus née des développements attendus dans les communications et de la plus grande latitude dans les heures fixées à ces déplacements.

Or, étant donné la grande difficulté qu'il y a à prédire les choix que les consommateurs sont susceptibles de faire, et le comportement ou les attitudes qu'ils adopteront face aux compromis en matière de réduction des dépenses de transport, seul un projet pilote soigneusement étudié pourra déterminer avec justesse si les ménages canadiens sont disposés ou non à participer assidûment à une entreprise de co-voiturage quelconque. Le rapport propose un programme en six étapes visant à mettre en évidence la faisabilité d'un projet de co-voiturage au Canada.

18. Mots-clés	19. Diffusion
Transport. Co-voiturage. Véhicules. Automobiles. Propriété.	L'agence commanditaire dispose d'un nombre limité d'exemplaires.

20. Classification de sécurité (de ce rapport)	21. Classification de sécurité (de cette page)	22. Nombre de pages	23. Prix
Non-classifié	Non-classifié	87	Aucun

CDT TDC 79 005

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the advice and assistance provided by the following:

Judith Nogrady - Transportation Development Centre

Richard P. Steinmann - Urban Mass Transportation Administration, U.S. DOT

Paul F. Fish - Urban Mass Transportation Administration, U.S. DOT

Michael J. Doherty - Purdue University

Kjell Dahlström - University of Lund

We are also most grateful for the comments provided by the project Steering Committee and would like to, in particular, acknowledge Mrs. Ling Suen of Transportation Development Centre.

Project Committee Members:

Ling Suen - Transportation Development Centre, Transport Canada

Pat Hallet - Research and Development, Transport Canada

Arjan Chandan - Surface Policy Planning and Urban Programmes, Transport Canada

Hani Mokhtar - Energy, Mines and Resources Canada

Terry Robbins - Ministry of Transportation and Communications, Province of Ontario

This project was funded by Transport Canada under the Urban and Regional Transport Subprogram of the Department's Energy Research and Development Program. This program is part of the Federal Energy Research and Development Program sponsored by the Interdepartmental Panel on Energy Research and Development.

SUMMARY

This report presents the results of the study "Shared Vehicle Fleet Concepts: State-of-the-Art Review and R & D Program Definition".

A variety of shared vehicle fleet concepts have been developed to:

1. provide better matching of vehicle attributes to specific trip requirements;
2. facilitate a net reduction in the level of total car ownership; and still
3. retain much of personal transportation freedom.

Most of the concepts are based on the use of two separate vehicle fleets:

- o personally owned, "immediate access fleet" consisting of minimum attribute vehicle(s) (MAV's) intended for each household's most frequent trips; and
- o co-operatively owned, "group access fleet" consisting of general attribute vehicles (GAV's) providing guaranteed access based on advance reservations.

The reduction in use, and ownership, of typical 'compromise' vehicles - which tend to be too large for a vast majority of trips - will result in significant increase in transportation energy (and money) efficiency. Households can be relieved from purchasing, garaging, insuring and maintaining seldom used excess vehicle capacity. These concepts are highly complementary to other conservation measures, i.e. regular car/van/bus pooling and the use of public transit. They <u>increase</u> the range of public and private transportation alternatives from which households and individuals can select the most cost-effective 'package' of mobility to best meet their specific travel needs.

The review of current systems has established that, together with related societal benefits (eg. increase in

leisure space in residential areas due to reduced parking space requirements), these benefits can be substantial enough - in a carefully designed and managed enterprise - to offset the disbenefits of:

- o possible delays in access to a vehicle
- o need for advance planning and for keeping reservation commitments
- o required signing of binding legal agreements
- o costs of managing the shared fleet operation
- o loss of individually owned two-car status.

The ultimate success of an enterprise will heavily depend on its specifications - eg. careful selection of the site (which in part controls the possible membership composition) and fleet composition, and the definition of suitable operating rules. A well controlled reservation system and an equitable basis for setting user charges are of particular importance in securing the success of an enterprise. An assessment of these factors is summarized within this report.

The state-of-the-art review has indicated four important developments in shared vehicle fleet (SVF) experiments:

- o past experiments in using shared vehicle fleets as central business district (CBD) circulation systems, such as Procotip in Montpellier (France) and Witkar in Amsterdam, have met with clear failure;
- o a gradual shift has started toward relatively small scale residential co-operatives managed by transportation brokers, and toward other previously untested innovative schemes;
- o the recent renewed interest has resulted in important major demonstrations, particularly in Sweden and the U.S.; and
- o development of distance/time driven charge units operated by magnetic I.D. cards, and of related vehicle monitoring and reservation systems, is underway and unlikely to pose any major problems.

Based on the review of recent socio-economic and travel trends, there appears to be significant theoretical opportunity for implementing shared vehicle fleet schemes in Canada also, mainly due to:

- o the economic pressures on households and individuals to reduce the transportation component of their budgets; and
- o the significant time/space flexibilities in current discretionary travel, and the increased flexibilities in all travel resulting from the expected alternative work schedule and communications developments.

It is important to recognize that - while these opportunities appear significant - they are, at this point, only theoretical. Because of the immense complexity of predicting consumer choices in this intricate attitude/behaviour vs. cost savings trade-off environment (for which no time series data exists), only the implementation of a carefully designed demonstration program will establish the true propensity of Canadian households to join, and to continue to participate, in shared vehicle fleet enterprises. This report recommends a six step program for demonstrating the feasibility of implementing shared vehicle fleet operations in Canada.

TABLE OF CONTENTS

		Page
1.	INTRODUCTION	1
	1.1 Background	1
	1.2 Problem Statement	1
	1.3 Proposed Solution	3
2.	STATE-OF-THE-ART REVIEW	7
	2.1 Definition of Shared Vehicle Fleets	7
	2.2 Specifications	8
	a. Membership Composition	8
	b. Membership Size	9
	c. Fleet Composition	10
	d. Fleet Size	11
	e. Service Definitions	11
	f. Pricing System	13
	g. Institutional and Legal Matters	16
	2.3 Past, Current and Planned Experiments	17
3.	BRIEF REVIEW OF RELEVANT SOCIO-ECONOMIC TRENDS	23
	3.1 Household Expenditures	23
	3.2 Travel Behaviour	25
	3.3 Alternative Work Schedules	37
	3.4 Implications of the Trends	37
4.	RESEARCH AND DEVELOPMENT PROGRAM DEFINITION	40
	Step 1 Establish a Monitoring Program	43
	Step 2 Institutional Issues Review	43
	Step 3 Preliminary Site Selection and Survey	44
	Step 4 Feasibility Assessment	46
	Step 5 Design of Demonstration Program	47
	Step 6 Initiation of the Demonstration	48

LIST OF EXHIBITS

		Page
1.	PAST, CURRENT AND PLANNED EXPERIMENTS	18a
2.	AVERAGE ANNUAL DISTANCE DRIVEN PER LICENSED DRIVER BY NUMBER OF DRIVERS AND NUMBER OF VEHICLES IN THE HOUSEHOLD	27
3.	ESTIMATED ANNUAL DISTANCE DRIVEN WITH SHARED VEHICLES BY AN AVERAGE MEMBER HOUSEHOLD	29
4.	AVERAGE ANNUAL DISTANCE DRIVEN PER LICENSED DRIVER BY AGE GROUP AND SEX	30
5.	AVERAGE DAILY FAMILY TRIPS BY STAGE IN THE TRADITIONAL FAMILY LIFE CYCLE	32
6.	AVERAGE ANNUAL KILOMETRES PER VEHICLE BY HOUSEHOLD VEHICLE OWNERSHIP AND ANNUAL HOUSEHOLD INCOME	33
7.	DISTRIBUTION OF VEHICLE TRIPS BY TRIP PURPOSE AND NUMBER OF OCCUPANTS	35
8.	AVERAGE OCCUPANCY BY DAY OF WEEK AND BY TRIP PURPOSE	36
9.	RESEARCH, DEVELOPMENT AND DEMONSTRATION PROGRAM - DIAGRAM	42
10.	SURVEY OF POTENTIAL SVF ENTERPRISE MEMBERS - PRELIMINARY QUESTIONNAIRE CONTENT -	45

LIST OF APPENDICES

A	PROCOTIP - Summary Description
B	WITKAR - Summary Description
C	THE PURDUE MOBILITY ENTERPRISE - Summary Description
D	STAR - Summary Description
E . 1	SUMMARY OF FAMILY EXPENDITURE BY FAMILY INCOME 16 Cities, Canada, 1978
E . 2	CONSUMER PRICE INDEXES FOR CANADA Major Components, Selected Sub-groups and Special Aggregates
F	AVERAGE VEHICLE TRIPS AND VEHICLE KILOMETRES PER HOUSEHOLD AND AVERAGE TRIP LENGTH BY NUMBER OF
	F.1 PERSONS IN HOUSEHOLD
	F.2 EMPLOYED PERSONS IN HOUSEHOLD
	F.3 LICENSED DRIVERS IN HOUSEHOLD
	F.4 VEHICLES IN HOUSEHOLD
G . 1	TRADITIONAL FAMILY LIFE CYCLE: SELECTED FAMILY CHARACTERISTICS
G . 2	AVERAGE VEHICLE TRIPS AND VEHICLE KILOMETRES PER HOUSEHOLD AND AVERAGE TRIP LENGTH BY HOUSEHOLD STRUCTURE
H	SHARED VEHICLE FLEET CONCEPTS - Related Terminology
I	REFERENCES

1. INTRODUCTION

1.1 Background

The energy situation, despite a recent world oil glut, has changed fundamentally very little. It remains serious, as conventional petroleum reserves are fast running out and there are significant problems in bringing any of the non-conventional reserves on-stream. In order for Canada to reduce its oil balance-of-payment deficit - towards ultimate self-sufficiency - major programs must be developed, and implemented, within a comprehensive strategy of conservation and shift to alternative fuels in all sectors.

The transportation sector, which uses about half of all petroleum products, will be expected to contribute significantly over and above savings that will result from technological efficiency improvements (eg. the U.S. legislated CAFE standards). Indeed, significant additional conservation opportunities have been identified. Through the implementation of a wide range of complementary incentive/disincentive measures, load factors in all modes could be substantially increased, additional shifts to transit could be achieved and even the (previously taboo) overall travel demands could be reduced. This study is designed to investigate recent developments in one of these measures - shared vehicle fleets.

1.2 Problem Statement

In the transportation sector, the automobile consumes a lion's share of energy - while being operated most of the time with great unused capacity, i.e. vacant seats and empty cargo space. Some eighty percent (80%) of automobiles have more than four seats, while only twenty percent (20%) of all trips need that many. Also, judging from the number of cars parked outside owners' residences at any given time, there is

an enormous amount of redundancy in the urban car fleet. If private passenger transportation were considered as an industry ("manufacturing" mobility), it would be, by far, the lowest productivity sector. There are a number of other developments which - from the stand points of general efficiency and energy conservation - cause serious concern:

- o increases in travel demands by, largely, single occupant automobiles continue to put a significant strain on the transportation infrastructure - resulting in increased levels of arterial and freeway congestion (therefore energy waste) just when available financial resources and transportation system considerations allow only very limited capacity additions since moneys are needed for maintenance and rehabilitation;

- o the present economic circumstances, with little relief in sight, have seriously constrained the expenditures of average households - while the needed reductions on the transportation side have become difficult to realize because of increases in real prices of fuel and vehicles coupled with the continued reliance, particularly from low and medium density residential areas, on personally owned automobiles for transportation access;

- o transportation mobility is becoming increasingly limited in terms of choice of vehicles that any one typical household can practically and economically own - frequently resulting in "compromise" vehicle(s) not really best suited for much of the travel needs (typically, much too large for majority of trips);

- o technological developments towards greater fuel efficiency - while by far the most important conservation measure presently being implemented - amount to, really, a "one time shot in the arm", leaving basic usage inefficiencies almost unchanged while also being very costly to the consumer; and

- o efficiency oriented developments in the social scene - eg. locating homes closer to work place and vice versa, emergence of compressed work week and telecommunications as a replacement for travel - while presenting significant conservation potential, are all emerging quite slowly.

These developments suggest an increasing challenge to transportation professionals: how to offer the widest possible range of alternatives from which each household and individual can best select the most cost-effective "package" of mobility to meet specific travel needs. These travel or access needs

depend, in each instance, mainly on:

- o household location relative to its members' work/ school/shopping places (and choices)
- o life cycle stage: marital status, age cohort, children
- o leisure activity choices and orientations.

These factors, coupled with the household's financial capability and personal preferences and attitudes, present a very complex planning framework - which, in fact, can not be resolved on any individual's behalf. However, new and innovative options can be made available.

1.3 Proposed Solution

In addition to technological developments, there are three main strategies for energy conservation in the passenger transportation sector:

- o increased efficiency within each mode
- o selected modal shifts (to transit, to walk/bicycle, to moped/scooter)
- o reduction in person travel demand.

General publicity campaigns to make the public adapt a conservation philosophy, have been followed with specific measures to support:

- o use of public transit
- o shift to ridesharing (car, van and bus pools)
- o implementation of shared ride taxi

Marketing programs have emphasized the monetary advantages of these modes. Transit information and carpool matching programs have been implemented, and in some instances, supported by preferential or exclusive treatment of high occupancy vehicles (eg. exclusive lanes and by-pass ramps, preferred parking locations).

These efforts, while of critical importance, have so far met with only limited success - eg. the average peak period load factor across Metro Toronto boundary is only about 1.25, rather meager from a productivity stand point. The public-at-large has not been ready to give up the personal freedom associated with owning automobiles, ie. the guaranteed, reasonably immediate access (constrained only by other family members' needs) and the flexibility of personal control (travel direction and time changes on a whim). The recently declining real prices of fuel have not helped, but encouraged a certain complacency in Canadian people about the importance of energy conservation. New innovative approaches must be developed to complement the other conservation programs and to address specific, and up until now unreached, target markets.

There are a number of shared vehicle schemes that would seem to fit the requirements. These schemes have been developed to:

- o provide better matching of vehicle attributes to specific trip requirements - towards significant potential gains in efficiency;
- o facilitate a reduced level of total car ownership - in order to reduce the waste capacity of the present fleet; and
- o still maintain much of the personal transportation freedom so ingrained in North American society.

These objectives could be achieved, at least by some proportion of the car owning households, through the utilization of two separate vehicle fleets:

- o A personal "immediate access fleet" designed for households' most frequent trips (eg. work, much of shopping) requiring limited capacity. Each household could select its own "minimum attribute vehicle" (MAV) with only the absolutely necessary attributes needed for perhaps seventy to eighty percent of its members' typical trips.
- o A "group access fleet" - providing guaranteed access, based on advanced reservation during peaks, to a fleet of mostly larger and specialty vehicles. Also small

vehicles would be provided for a member's use when his/her MAV is unavailable.

The charms of this concept are, at least theoretically, fairly obvious:

1. it provides the most economical means of accomplishing each household's most frequent trips - and certainly does not restrict a household from seeking even further efficiency improvements if and when so desired, ie. car pooling arrangements and use of transit, walk, bicycle, moped or scooter.

2. household is relieved from purchasing, garaging, insuring and maintaining a seldom used excess capacity (whether a second vehicle, or a "compromise" single vehicle); also, the criteria for purchasing the household's MAV (as opposed to a "general attribute vehicle", GAV) will be much simplified and more manageable.

3. the range of vehicle types within each household's convenient reach is significantly increased providing an increase in the quality of travel experiences;

4. reduced total expenditures for the provision of transportation access - savings through (1) and (2) coupled with economies of scale in the procurement of both GAV and MAV vehicles, fuels, maintenance, etc. - which can be transferred to cover other household expenditures or even to increase real transportation mobility (eg. to cover motel bills).

5. the societal benefits of:

   - eased parking in residential areas - making additional space available for playgrounds or increased density

   - extending, at least partially, car ownership to those presently unable to either manage or afford it

   - reduced congestion and fuel consumption, through more efficient and more sparing use of vehicles

   - increased community spirit and involvement.

These benefits could be substantial enough in a well designed system, to offset the disbenefits of:

- possible delays in access to a vehicle (fairly substantial in past experiments)

- need for some advance planning (to reserve a time slot), and the need to keep reservation commitments
- need for some paper work, including binding legal agreements
- some out-of-pocket expenses, and the costs of managing the shared fleet operation
- loss of individually owned two car status.

A few experiments have been tried in the past, based on some of the shared vehicle concepts (for related terminology, see Appendix H) - but with a rather modest success. However, because of the tightening economic and transportation circumstances, there is emerging a renewed interest in this field - with research and development work already underway. A summary of the state-of-the-art in this field is presented in the following - with an emphasis on currently planned experiments in the United States - followed with a brief review of relevant socio-economic trends and an outline for a possible research, development and demonstration program.

2. STATE-OF-THE-ART REVIEW

2.1 Definition of Shared Vehicle Fleets

Shared vehicle fleets are considered - for the purposes of this report - to include all jointly owned, managed or accessed fleets of "general attribute vehicles" (GAV's) which are designed to complement personally owned "minimum attribute vehicles" (MAV's). Conventional car/van/bus pooling and transit are not included.

There are five basic administrative concepts for operating shared vehicle fleets:

1. Rental Agencies - in this concept some rental agencies would:

   a) diversify their fleets by adding special purpose vehicles - large sedans, vans, wagons, jeeps, trucks, recreational vehicles, micro/minis, motorcycles/scooters/mopeds, .. - to their existing fleets

   b) offer streamlined discount reservation service for special identification/charge card holders

   c) open up very localized offices near high/medium density mixed or residential development areas, possibly in co-operation with a service station chain.

2. Automobile Companies - a manufacturer, in co-operation with its dealership, would expand and diversify current rental operations (of general attribute vehicles) to complement their sales or leasing (of minimum attribute vehicles) to members.

3. Transportation Brokers - existing rental companies or new independent brokers would offer a management package - for financing, insurance, day-to-day operations, maintenance - and assemble localized user pools on a sign-up/subscription basis by marketing the service.

4. Neighbourhood Coordinators - fairly close-by neighbours would set up an enterprise, designate a coordinator and:
   - carry out all functions internally through assigned or rotating responsibilities, or
   - engage an outside broker for day-to-day management, in accordance with enterprise guidelines.

5. Downtown Brokerage - in which the management is arranged as in (3), but the co-operative or open pool fleet is intended to operate between designated terminals or parking lots within fairly limited downtown core. The vehicles are usually very small - two seater conventional or electric micro/minis or even scooters, mopeds or bicycles. Potential brokers include municipalities, chambers of commerce, etc. and even transit operators (to provide "diagonal" service).

In all of these concepts an essential element is that during a relatively short term use of a shared vehicle it is operated by the user, unlike in individualized point-to-point services such as taxi, jitney or dial-a-ride.

2.2 Specifications

There are a number of elements which must be clearly specified in order to lay out a proper context for the operation of a shared vehicle enterprise. These elements and some related general comments are presented in the following:

a) Membership Composition

Age

- o Adult: Head of a household would be the main subscriber. Employment status, credit worthiness and details of driving record would have to be established and monitored.

- o Retired: The activity patterns and flexibilities of retired people would tend to make their vehicle requirements highly complementary (ie. non-overlapping) to other members' requirements - thereby increasing the all important utilization rate.

- o Elderly: The chance to avoid the usual fuss of car ownership could attract significant numbers of elderly to these schemes. Recent and continuous driving experience would be desirable for safety/insurance reasons. The increasing number of elderly in society may ultimately have an impact on the composition of typical SVF's.

- o Young (16-24): Some of the expected usage patterns would be complementary to other groups. Main concern would be the possible rough and inexperienced handling of "somebody else's vehicle". Minimum desirable driving experience might be in the order of 60 000 km - to reduce related insurance liabilities and costs. Purdue University has set 21 as the

minimum age for their experiment.

Income Groups
- o Households with different disposable incomes will have different expectations for the minimum attribute vehicle (MAV) - mostly, however, in terms of luxuries and not in terms of size.
- o For some low income, non-car households, the shared vehicle schemes will be the only practical means of gaining access to a car. The rate of usage could be expected to be less than with other groups, and focused on non-transit travel purposes/ times/directions.

Occupations
- o Certain mix will be highly desirable for increased variety of travel (time) needs in order to increase utilization of the fleet. Some of the useful extremes would include: shift workers, and different seasonal vacation preferences and opportunities.

Residence
- o Convenient access to the shared fleet will be critical. Residences concentrated in medium or high density developments, at walking distance from the central garage or parking, would enhance the chance for success. Locating near a mixed commercial/ residential development would increase the variety of possible fleet uses, by commercial weekday subscribers - and could make implementation attractive to current rental agencies or new transportation brokers.
- o Small/medium size businesses, in close proximity within commercial or industrial sites, might also find the shared use of a specialized fleet cost-effective, and could - through weekend access to employees - further increase the utilization rates.

Social Factors
- o Personal hygiene/vehicle cleanliness habits, household pets, drinking/driving habits and seat belt usage are likely to emerge as the critical social factors. The latter two will have to be covered by enterprise legal agreements to minimize insurance costs.
- o Groups of disabled could find shared ownership schemes a cost-effective means of accessing a fleet of specially equipped vehicles - while also keeping insurance costs reasonable.

b) Membership Size

Theoretically, the larger the group the greater the predictability of non-availability and delay in getting of

vehicles. This would mean a decrease in the necessary safety margin of extra vehicles, and therefore a higher productivity. Some recent modelling suggests that half of available gains will be made when a Purdue type system increases from 20 to 50 members - after which only a modest improvement in vehicle ratio can be realized. In practice, group size is controlled by location/convenience factors and - depending on the scheme adopted - by constraints of initial funding, day-to-day management requirements and the transportation circumstances (competing modes and the level of congestion in the CBD schemes).

c) Fleet Composition

The mix of vehicle types is controlled primarily by usage patterns (trip purpose, length and load factor) - and, particularly in the beginning, by the composition of the fleet of members' current personal vehicles (type and age). Each member household can be expected to try to optimize the restructuring of its fleet (resale, disposal, exchange) - leading, over time, for most households to a personally owned MAV/group owned GAV combination. There will be variations on the theme, eg. between households who will ultimately want to own two, one or no vehicles.

The membership size, ie. the fleet size, will also control the number of vehicle types that can be offered, eg:

- o large sedans
- o vans
- o station wagons
- o jeeps
- o other recreational vehicles
- o small trucks
- o micro/mini cars
- o motorcycles/scooters/mopeds

On-board equipment choices will have to be made on:

- o stick shift vs. automatic transmission
- o power steering
- o air conditioning
- o trailer hitch
- o special controls - maximum speed control
  - tachograph (for monitoring usage 'roughness')

- enterprise charge unit for inserting the I.D. card

Schemes that may start up with used group vehicles (usually 2-3 years old) will have somewhat different choices than schemes with brand new vehicles.

d) Fleet Size

Based on the membership size and usage rates, there are two controlling factors affecting the size of a fleet:

- o delays associated with vehicle availability must be kept to a practical minimum; and
- o performance for the entire operation - individual plus group vehicles - must guarantee significant savings over previous, non-shared transportation arrangements.

The clear and honest documentation of the assumptions and expected cost/revenue performance will be one key feature in marketing any of the schemes if they are to stay solvent.

Probability theory can help to understand the relative importance of factors that affect fleet size - however, only actual implementation can yield decision quality information on the full range of the extremely complex group dynamics in any of the schemes at any specific location (with specific membership, travel patterns, etc.).

e) Service Definitions

A well controlled and equitable reservation system will be one of the critical factors in establishing a successful operation. For regular day-to-day usage, a first come/first served system may be preferred since it rewards the ability to plan in advance. However, this must be complemented by an adequate cost penalty through the pricing system - for those that then may fail to utilize the vehicle held in exclusive reserve for them.

An interactive minicomputer system located at the main garage/office with terminals at subscribers' homes could be the ultimate for a bigger scheme. However, it would require careful planning and experimentation, and a basic telephone/log book system may be a more likely and practical one for the time being.

Some literature has mentioned the possibility of a continuous auction, rewarding a contested vehicle to the highest bidder during peak demand periods. This could be one of the fastest ways of tearing a membership apart.

Summer Peaks will be hard to handle and will require carefully drawn-out rules, advance warnings and commitments from members - as well as a flexible process of negotiation between competing members.

Hours of operation will depend on the size of membership and usage patterns and the scheme adopted. Attendants working in two shifts are being considered for one scheme currently in feasibility stage. Methods of pick-up and drop-off must be set accordingly, particularly if offered (for a charge) by the scheme. In some schemes this is handled by the attendant or the member taking along a fold type bicycle where the distance was too long for walking.

Any restrictions on the usage of any of the vehicle types, eg. no pushing or pulling of loads, etc., must be clearly outlined (see legal). These may also include at least some suggested levels of vehicle interior/exterior cleanliness expected from each member when returning the vehicle.

The responsibilities of keeping certain type of trip records, in manual or semi-automated vehicle based charge systems, must be specified - and proper forms provided and monitored accordingly.

f) Pricing System

It is a well established fact that an average motorist is exceptionally skilled in grossly underestimating his/her cost of owning and operating a vehicle. According to one theory, this is based on a clever, unconscious deception process by which we supposedly are trying to cover up the unpleasant cost realities from harassing our day-to-day enjoyment of one of life's few remaining luxuries. Be that as it may, a comprehensive pricing system will have to be based on full cost/revenue accounting and be as fair and equitable as possible. For marketing purposes, the documentation must be very clear with detailed individualized cost comparisons between staying with one's current practice (eg. owning one or two GAV's) vs. joining an enterprise (eg. one personal MAV + group GAV's)

In terms of final user charges, conventional rental car systems are not expected to compare favourably with SVF enterprises due to:

- present locations less convenient to a typical group of members
- greater management, marketing and facilities costs
- the requirement to make a significant profit.

However, some agencies may be prepared to establish GAV fleets specifically tailored to the needs of residents and businesses of a small area and operate them as transportation brokers on small profit margins (ie. management concept (1) on page 7).

The basis for setting user charges will have to include the following (accumulated from vehicle specific information where appropriate):

- o financing charges - capital cost and amortization
- o anticipated resale value - low estimate discounted (any unexpected gains to reduce the following year's average rates).

- o interest revenue on first and last month member security deposits
- o operating costs
  - licencing and registration
  - insurance (individual & group)
  - garaging & parking
  - maintenance
    - . scheduled preventive
    - . unscheduled (estimated breakdowns)
  - day-to-day management
    - . facilities
    - . equipment
    - . personnel
- o assumed usage rate for each fleet vehicle

The criteria by which the total charges are applied to each 'rental' of each vehicle should include the following:

- o distance driven
- o time held outside the system garage/recording
- o gasoline purchased (will require a tamper-proof method)
- o any unexpected maintenance expenses (eg. quick charge, etc.)
- o time period : peak/off-peak (within a day, week or season)
- o and possibly
  - handling of the vehicle (as monitored by tachograph)
    - . smooth & medium speed
    - . abrupt & high speed
  - "return delay" penalties (when others waiting)
  - "failure to pick-up" penalties (when others had also attempted to reserve the same time slot)
  - vehicle interior/exterior extra cleaning penalties
  - .....

The basic issue in setting up the specifics of a charge system is whether to distribute all costs on the basis of distance driven and time held in individual possession, or distribute some of the costs (eg. financing charges) equally amongst the members. The latter may be convenient when the annual distances driven plus time held in possession are expected to be roughly the same between members. All inclusive distance/time distribution would in most instances tend to be more equitable - and more direct in terms of highlighting, during each 'rental', the true unit costs of usage.

This could lead, over time, to a more frugal attitude in making incremental travel decisions: resulting in some consolidation of trips, in some redistribution from distant to closer-by destination choices, and even in some net reduction in travel (use of telecommunications or foregoing of travel); all most admirable bonuses from a conservation standpoint.

In setting up the differentials for peak/off-peak usage (by vehicle type), a basic decision must be made whether to use the revenue to:

- o cross-subsidize off-peak period users
- o purchase additional peak capacity.

In the interest of maintaining a stable membership, a combination of the two would probably offer the best balance between efficiency and equity.

How 'complicated' a charge system can ultimately become, is also controlled by the equipment adopted. The choice is between a totally manual, minimum-information diary, and an interactive micro computer system which may monitor a wide range of vehicle performance and handling information in addition to the user I.D./travel purpose information. For sound vehicle acquisition decisions, a fairly complete information base becomes essential - rewarding those that are prepared to spend some time and effort in developing suitable, easy-to-use recording mechanisms and formats. When these schemes become more widely used, standard forms and recommended approaches are likely to quickly emerge.

Whatever the initial system of distributing costs, adjustments can (must) be made after usage patterns of the first complete year have been tabulated and reviewed by the entire membership.

g) Institutional and Legal Matters

A number of rules and responsibilities will (usually) have to be legitimized to secure smooth operation and establish a clear basis for arbitration. These agreements, amongst the enterprise members or between a broker and the members - and possibly a third party (eg. apartment complex owners and management) - will specify the day-to-day management procedures, vehicle licencing and registration, criteria to be used in calculating 'rental' costs, and criteria to be used for screening membership candidates. The latter may include:

- o age (eg. at least 21)
- o employment status & credit record
- o residence location (eg. specific apartment complex or wide open)
- o driving record, e.g.:
  - . accident free 3 years
  - . arrest free 5 years
  - . points and convictions
  - . automobile insurance record (type and number of claims)
  - . 60 000 km minimum experience
- o willingness to sign legal and binding agreements on:
  - no operation under influence of alcohol or drugs
  - usage of seat belts and proper infant seats at all times
  - restricting all driving to card holding members only (eg. not taking out a pool vehicle for 16 year old children to 'tool around' to 'gain practice')
  - restricting the purpose of usage to personal transportation only (ie. no for-hire driving)
  - any restrictions on the use of trailer hitches etc.
  - methods for - resigning from the enterprise (penalties?)
    - dismantling the enterprise (ie. who has the authority to sell the fleet and how will costs/revenues be shared)

The latter legal agreements are an important means of reducing the extra insurance costs, otherwise imposed on any joint fleet - and therefore will have to include a waiver significantly limiting any insurance liability in the case of an accident, in which the driver was not abiding by the above restrictions. Obviously a member who has taken a vehicle

'out' would also be assuming full responsibility for any fines, summonses, etc. resulting from traffic violations during that period.

The agreements should also establish whether members are allowed to purchase vehicles which have reached the end of their useful fleet service lives - and the basis on which resale prices, in such instances, are to be established.

In a somewhat softer area, but still possibly worthy of some specification, are factors such as:

- o recurring late return of vehicle
- o lack of sufficient interior/exterior cleanliness
- o rough handling of vehicle (tachograph record)

Institutional considerations would typically include the following:

- o licencing of rental agencies and other transportation brokers
- o municipal parking regulations
  - possible preferential location rate at selected municipally controlled lots - based on a shared vehicle sticker
  - reduced minimum provision of parking spaces for developments designed and committed to shared vehicle fleet operations (eg. a booth, priority spots, ...)
  - reduced residential permit fee
- o temporary exemption for microvehicles from federal safety regulations (30 mph crash worthiness test)

In a successful enterprise, the selected management structure, fleet composition/size/location and membership composition/size and the operating and user charge rules, should - in the end - all enhance rather than limit the quality of individual mobility.

2.3 Past, Current and Planned Experiments

Over the years various vehicle sharing concepts have

attracted greater attention in Europe than in North America, whereas the opposite is probably true for ridesharing. On both continents, however, there is a long history of similar shared concepts popular in other applications:

- o shopping carts (rented at malls); package carts (at airports)
- o merchant delivery systems (allowing modified personal vehicle purchase criteria)
- o local rent-alls (for joint tools, etc.)
- o recreational vehicles and equipment
- o boats and vacation residences
- o church buses; school buses (in non-school use)
- o joint ownership of cars by students
- o large employer motor pools (for employees' business use)
- o unofficial (and unheralded) carpooling to schools, ice-rinks, ...
- o shared taxi to/from airports; route taxi (eg. in Germany)
- o one man local rent-a-truck operations
- o large scale commercial vehicle rental companies
- o semi-legitimized hitchhiking during transit strikes
- o ..... and conventional car/van/bus pooling.

Many of these applications have required significant advance planning and 'member' commitment, as well as willingness to actually share with others - supposedly two of the key stumbling blocks in implementing shared vehicle fleets.

Even with the failures of some early experiments in shared vehicle schemes, it is no wonder then that interest in them has remained fairly constant over the years and has picked up lately. A summary of the main past, current and planned experiments is presented in Exhibit 1. There is a great variety of applications - starting from the famous Procotip of Montpellier to STAR, or Short Term Auto Rental, currently

EXHIBIT 1 : PAST, CURRENT AND PLANNED EXPERIMENTS

SCHEME		LOCATION		START	CURRENT	MEMBERSHIP		R/O	VEHICLES		TERMINAL	PLA
NAME	TYPE	CITY & CTRY	FOCUS	YR	STATUS	NO.	DEFINITION		NO.	TYPE	& SUPPORT FACIL's	EXPA
PROCOTIP	CAR CLUB	MONTPELLIER FRANCE	CBD	71	BANKRUPT 1973	360	50-100 ACTIVE MED. INCOME PROFESSIONALS	R	37	SIMCA 1000 4 PASSENGER LEASED	17 PARKING LOTS 57 NON-CONTROLLED SPOTS IN ALL	600 REP 120
WITKAR	CAR CLUB	AMSTERDAM NETHERLANDS	CBD	73	WITHDRAWN 1980	3400	50% INNER CITY 30% CITY 20% OUTSIDE	O	35	TWO-PASS'R EV 30 km/h 11 km MAX. DIST.	6 RECHARGING STATIONS 18 m OF CURBSIDE FOR 10 EV's (EXCLUSIVE ACCESS)	I. 1 & 1 ION II.1 & 1 ION
GREEN CAR	CAR CO-OP	LONDON & MILTON KEYNES, U.K.	URBAN NON-WORK	75	20 ACTIVE SCHEMES	2 HOUSEHOLDS & MORE	TWO PROFESSIONAL FAMILIES	R	1	CITROEN AMI ESTATE	NONE (PARK AT HOME) OTHER TRANSP'N = TRANSIT & BICYCLE	REPO 198
TAXISTOP	COST SHARE HITCH HIKING	BRUSSELS BELGIUM	METROPOLITAN COMMUTING & VACATION	78	ACTIVE	N/A (LARGE)	PHOTO ID CARDS FOR TAXISTOPPER & MOTORIST (AS PERMIT)	O	N/A	VARIOUS	NONE (CENTRAL RECORDS OFFICE) BUS STOPS UNDER CONSIDERATION	UPON STUD AUS
BUDGET	CAR RENTAL	WASHINGTON D.C. U.S.A.	URBAN WEEKEND (RURAL)	81	ACTIVE	N/A	60% NON CAR CBD RESIDENTS	O	300-400	VARIOUS	DOWNTOWN RENTAL OFFICE & PARKING AT CBD & AIRPORT	COND APT. OTHE
SAMBIL	PRIVATE CAR HIRE	VÄSTERÅS SWEDEN	URBAN NON-WORK	80	ACTIVE	51 HSE HOLDS	25 CAR OWNERS 26 NON-CAR OWNERS	R	30	VARIOUS	NONE (PARK AT HOME)	UPO
HYRBIL	CAR CO-OP	ÖREBRO SWEDEN	SUBURBAN	83	PLANNED	N/A	MED.INCOME ROW HOUSES	R	20	MINI CARS + TWO VANS	SERVICE STATION OTHER TRANSP'N= GOOD TRANSIT	
MOBILITY ENTERPRISE	CAR CO-OP	WEST LAFAYETTE U.S.A.	SMALL URBAN	83	COMMITTED (6 MTHS MINIMUM)	I.8-15 HOUSEHOLDS II.30 HOUSEHOLDS	PURDUE FACULTIES & STAFF (NOTE: DRIVER QUALIFICATIONS)	R	10 MAV's ? GAV's	SUZUKI ALTO 4-PASS/4SPEED MANUAL (570 kg) INTERM.+ FULL +WAGON & AUTOMATIC & A/C	MAV's AT RESIDENCES GAV's AT PURDUE	20 MA TRU CO AT
STAR	CAR RENTAL	SAN FRANCISCO	URBAN	83	FEASIBILITY STUDY	N/A	RESIDENTS OF APT.COMPLEX	R	70	MICRO/MINI SUB COMPACT MID SIZE	BOOTH & OFFICE NO PARKING (ie. FLEET ONTO 70% OF PREVIOUS SPOTS)	BAS DE RE

ED ION	VEHICLE AVAILABILITY HOURS	USAGE	RESERVATION	METERING DEVICE	PRICING	FUNDING	COMMENTS
RS TO CE	24 h	160 km PER WEEK PER VEH.	NO CONTROL	CIRCULAR PLASTIC TOKEN MUTILATED AT THE EDGE BY THE METER IN PROP'N TO DISTANCE TRAVELLED	DISTANCE ONLY (11.2¢/km) PURCHASE AHEAD OF TIME POSSIBLE BREAKEVEN 30 USERS /DAY/VEHICLE	MUNIC'Y = PARKING GVT = 10 CARS MEMBER FEES (INCL.60Frs INITIAL)	CRUISING FUEL FILL & PAYMENT WHILE IN USE FAILURE IN PLANNING, MARKETING AND MGT. (eg. NO PARKING ENFORCEMENT) METER MALFUNCTIONS = DOWNTIME
CARS STAT-	11h-17h	15%	VOLUNTEER ATTENDANTS	MAGNETIC'Y CODED CARD STATION ISSUED KEY AUTOMATIC TIME RECORDING	TIME ONLY (4¢/min) PAY END OF EACH MONTH BY DIRECT DEBIT	GVT = PARKING BUSINESS MEMBER FEES ADVERTISING	COMPUTER TO CHECK DESTINATION AVAILABILITY, ON-LINE CREDIT, THEFT OF KEY, ... CBD CIRCULATION-AID CONCEPT NOT SOUND
0 CARS STAT-	24h		MINICOMPUTER				
IN	9 AM-9 PM	10500km PER YR	NOTEBOOK IN THE CAR & TELEPHONE	I. MANUAL LOG BOOKS II. "PAY DRIVE METER" RECOGNIZES 19 DIFFERENT KEYS & SHOWS COSTS ACCUMULATED	I. GAS COSTS BY DISTANCE & OTHER COSTS HALVED II. ALL COSTS DISTRIBUTED BY DISTANCE & TIME	I. MEMBER FEES II. MEMBER FEES OPEN UNIVERSITY	NUMEROUS 2-3 HOUSEHOLD MANUAL SCHEMES NEW METER UNDER DEVELOPMENT MORE HOUSEHOLDS & COMPLICATED CHARGE CRITERIA
EMAND	COMM'G PEAKS	N/A	NONE-EXCEPT FOR VACATION	VEHICLE ODOMETER	DISTANCE ONLY:1 F/km PAID BY TAXISTOPPER TO MOTORIST VACATION ARRANGEMENTS SEPARATE	MEMBER FEES 300F/HOUSEHOLD/YR 50F FOR EXTRA VEHICLE	EXTRA FAMILY INSURANCE FOR TAXI STOPPERS CAR POOL MATCHING SERVICE.BREAKDOWN & SECOND HAND SELLING AND BUYING SERVICE INTERNATIONAL "VACATION LIFT"
IN ALIA	SUMMER	1000FOR VAC'N	INFORMAL IN-VEH. ARR'TS.				
INIUMS MPLEX CITIES	7 AM-6 PM	HIGH	PHONE-IN & COMPUTER	CLOCK	TIME ONLY (AVR.DISTANCE IMPEDDED) $70 = 3 x 24h $90 = 5 x 24h	RENTAL FEES	FIRST DEMONSTRATION IN U.S. - NO CANADIAN PLANS YET (BUDGET'S NO. OF OFFICES PROVIDES FOR SOME 'SHARED USE')
DEMAND	VARIOUS	N/A	ONE-ON-ONE HOUSEHOLD AGREEMENTS	VEHICLE ODOMETER & CLOCK	DISTANCE + TIME RATES	PRIVATE TRANSPORT RES. DELEGATION	SOME CAR OWNING AND NON-CAR HOUSE HOLDS HAVE SIGNED MORE THAN ONE AGR'T TO INCREASE HIRED DISTANCE OR IMPROVE AVAILABILITY
0	7AM-10PM	N/A	PHONE & LOG BOOK	N/A	N/A	MEMBER FEES OIL COMPANY TRANSP'N RES. DELEGATION	HOPING TO HALVE NO. OF PRESENT CARS ONE YEAR DEMONSTRATION IN LUND WITH SIMILAR CONCEPT (HYR 125)
IHATSU S UNDER IDER-N	N/A	N/A	MAV: INDIVIDUAL CONTROL GAV:PHONE RES'N(6-10 DAYS/MONTH)	MANUAL TRIP DIARIES (FOR MAV's & GAV's) MICROPROCESSOR DATA ACQUISITION SYSTEM FOR VEHICLE PERFORMANCE AUTOMATED KEY PAD DIARY	MONTHLY FEE = $140-$180 INCLUDES USE OF MAV+10 $7 COUPONS FOR GAV's (GASOLINE SEPARATE) PEAK/OFF-PEAK DIFFER'L W/DAY = 2 COUPONS W/END = 3 COUPONS	$100/MONTH/HOUSEHOLD SUBSIDY FROM PRIVATE FOUNDAT'N MEMBER FEES	MAV's PROHIBITED FROM INTERSTATE (UNDER EXEMPTION FROM 30 MPH CRASHTEST) FEE COVERS ALL INSURANCE & MAINT'E & REG'N & LIC.& TAXES FOR MAV's & GAV's DRIVER I.D. TIED DATA BASE: FUEL ECONOMY & MISSION SEVERITY ETC.
ON LTS	TWO SHIFTS	N/A	PHONE ATTENDANTS AT BOOTH	MANUAL 'PEOPLE'CARDS WITH PUNCH CLOCK OR MICROCOMPUTER	N/A	UMTA (SMDP) MEMBER FEES CALIFORNIA DOT	ECONOMIC VIABILITY, AS BUSINESS VENTURE, LOOKS GOOD FOCUS GROUPS UNSUCCESSFUL - NOW PHONE INTERVIEWS OF PEOPLE & RENTAL AGENCIES

in the feasibility stage in California. These extremes also demonstrate the direction in which shared vehicle schemes are likely to develop in the future; away from the somewhat tedious inner city core circulation systems to residential based fleets - with non-work usage emphasis. Typically the basic concept, which may be a private co-operative or broker/rental agency system, can be expected to consist of two fleets (as per Purdue terminology):

- o individually owned minimum attribute vehicles (MAV's)
- o group (or broker) owned general attribute vehicles (GAV's)

These two fleets are inherent in all schemes presented in Exhibit 1, albeit not explicitly spelled out in that way even by their developers. This is because the MAV fleet may consist of not only some specially purchased micro/mini cars (as in the Purdue scheme), but of a variety of transportation means, eg. subcompact/compact cars, motorcycles/scooters/mopeds, bicycles, feet, or various forms of public transit. Schemes that hope to rely on the latter modes as the household's MAV, will have to be particularly well managed and located - to allow the household to let go of its only vehicle. The only suitable locations would tend to be mixed developments which also have a good level of transit service or good car-pooling opportunities. Certain demographic groups (eg. retired) might also be more ready to adapt to such partial vehicle ownership schemes.

Of the nine schemes in Exhibit 1, Procotip, Witkar, Mobility Enterprise and STAR are described in more detail in Appendices A, B, C and D respectively. For the Purdue scheme, some preliminary cost comparisons are also included. Even with extended enterprise periods, which would tend to be more realistic and favourable for staying with the current vehicle, these comparisons demonstrate the potential cost saving advantages of such schemes.

In a scheme where the households (now with 2 cars) are assumed to dispose of their larger vehicle (current GAV), keep and well maintain their smaller vehicle (as the MAV) with occasional use of any of their group vehicles, the cost savings could be expected to be significantly more. Obviously a household can further enhance these cost savings by deciding to carpool to work (in their MAV).

Such cost savings will have to be significant indeed to sufficiently offset the added inconvenience of pre-planning, risk of unavailability of vehicle, etc. It is basically immaterial whether these disbenefits are real or perceived - a program to market any shared vehicle scheme will have to address such trade-offs head-on. As an example, it may be necessary to point out that there are possible resolutions for the reservation conflicts when these do occur, ie:

- o accept a lift, or take taxi or transit
- o get a regular rental car (an enterprise may consider a back-up contract for reduced rates with a local agency)
- o take a walk, bike, moped, scooter or motorcycle
- o take a priority on own household's MAV
- o change travel time
- o next time, plan more ahead

These options are real in most circumstances, and not altogether unmanageable with a little practice (and a devotion to saving money).

A brief summary of the items documented in the inventory matrix (Exhibit 1) is presented in the following:

Location: The main activity is still in Europe - but with the success of Budget's Washington, D.C. application and the Purdue Mobility Enterprise and UMTA's STAR, U.S. may soon be in the lead role (as in ridesharing).

Focus: Past experiments of car clubs as CBD circulation 'aids' (to complement pedestrian, auto and transit systems) have failed. Focus is shifting to residental-based co-operatives with non-work emphasis, but also with significant work travel efficiency implications.

Status: Of the nine documented plans
- 2 have failed
- 4 are active (and successful)
- 3 are being planned (at least 2 will go)

Membership: Both open and restricted systems have been tried and will continue to be available depending on the scheme adopted (apartment complex co-op vs. rental agency at service station). Size will range from the likely quite popular 2-12 households to about 60 households, or 100-1000 people in some rental and hitchhiking enterprises.

Vehicles: All schemes contain both general attribute vehicles (GAV's) and minimum attribute vehicles (MAV's) in some form - ie, the MAV's may be a fleet of specially purchased micro/mini cars, households' current smallest vehicles, motorcycles/scooters/mopeds/bicycles, and all forms of transit. Very interesting will be the first-of-the-kind experiment at Purdue using micros with a U.S. government 30 mph test exemption.

Terminals: Support facilities will tend to be improvised, the co-operatives seeking maximum cost-effectiveness - and include:

- o at apt complexes
  - priority parking
  - an operating booth
  - recreation or storage room for office
- o at gasoline stations
  - contracted maintenance and washing
  - the entire brokerage operation

For jitney-type pick-up operations, such as Taxistop in Brussels, bus stops, special route-taxi stops etc. will be utilized.

Vehicle availability: Reservation systems will vary between phone and log book, and computerized systems - the latter initially at rental agency brokerages, then in larger private co-operatives. An 'ultimate' scheme would include the use of home terminals (which, for cost-effectiveness reasons, would be designed to do a lot of other things besides). Those able to plan ahead and stick to their commitments are likely to be rewarded by all the enterprise concepts.

Metering device: With today's micro-chip technology, which already is used for monitoring numerous functions in the latest vehicles, the development of a suitable charge unit (ie. flexible, easy-to-use, reliable) operated by a magnetic I.D. card is imminent (ie. as soon as there is demand). A complex shared-ride taxi meter is successfully operating in New Zealand, and at Open University development is underway for a distance/time driven co-operative meter.

Pricing: Systems based on full cost-revenue accounting, with peak/off-peak differentials, etc. which[2] distribute all costs on some weighted distance operated/time-in-possession basis, are likely to be most popular - since they are most equitable and informative. Various other price factors may be included in more sophisticated systems, even including 'mission severity' factors, etc.

3. BRIEF REVIEW OF RELEVANT SOCIO-ECONOMIC TRENDS

Based on a fairly extensive literature search and other background work, three variables have been selected as most relevant to shared vehicle fleet formation;

- o household expenditures
- o travel behaviour
- o alternative work schedules

A brief summary of each is presented in the following.

3.1 Household Expenditures

In Canada, the share of disposable income that an average household has allocated to transportation, has stayed remarkably consistent - at 11.5% - 13.5% - since the 1950's. An expenditure breakdown for urban families by income, based on a 1978 survey, is presented in Appendix E.1. The greatest share for transportation is expended by families with $12 000 - $30 000 annual incomes, while the low income families are severely restricted by the much greater relative share needed to cover food and housing.

More recently, an economic recession has forced changes in these relative shares, eg. resulting from exorbitant mortgage rates etc. Families have had to cut back - according to a recent Star poll for example (23 Oct 82) :

- o 53% on necessities - 17% on food
  - 14% on car and gasoline
  - 9% on clothing
  - 13% on other
- o 42% on luxuries - 22% on entertainment & recreation
  - 9% on trips & vacation
  - 5% on restaurants & luxury foods
  - 6% on other (cigarettes, alcohol,...)

Considering that the current recession will probably be of very long duration - it seems to be one of Nikolai Kondratieff's "Long Cycles" - these cut-backs are likely to

result in at least some permanent budget shifts. Since the transportation component has stayed essentially untouched in the past, the pressure for a real net reduction in that area will be significant - particularly so, as there seems to be leeway (if absolutely required) for reducing expenditures in this area, eg.:

- o in work travel : through ridesharing, use of transit, shorter work week, moving closer to work, ...; and
- o in non-work travel : through tripchaining, pooling, selection of closer-by destinations, ...

In part, the degree of change will depend on the relative position of the transportation component within the Consumer Price Index. In December 1982, at 280 (1971=100), it was only slightly higher than the index for all items (271), but significantly lower than the index for food (314). During the 1979-81 real increases in fuel price the transportation index has been held back by a low vehicle purchase index (215) [for more recent, 1981 indexed figures see Appendix E.2].

Any let-off in the future on the transportation side - eg. due to declining real price of fuel - can be expected to be 'eagerly' absorbed (up to a certain limit) by the most essential expenditure groups where recent reductions are most directly felt. This is in fact the case now.

It could also be speculated that under sufficient economic pressure there would be a gradual shift toward vehicle owners starting to 'perceive' that depreciation and other fixed costs are indeed part of the day-to-day costs of operating a vehicle. Concurrent, possible taxation measures by the Federal Government - which, for example, convert vehicle related company benefits to taxable personal income - would tend to further illuminate the true costs of owning and operating a vehicle.

- Under these economic pressures innovative new schemes, which allow both a reduction in total transportation expenditures and the maintenance of much of the conven-

tional "level-of-service", can be expected to draw the interest of at least some population segments.

3.2 Travel Behaviour

Current research into travel behaviour is focusing on two basic concepts:

- o lifestyle : how individuals and households allocate time to alternative activities
- o life cycle : number and age of adults and children in households (or household structure).

The emphasis has been on trying to understand allocation of time to various activities, of which travel itself is only one. It is considered also to be a derived time allocation, expended only in order to connect two real activities, eg. in-house time and shopping. Canadian data, that would categorize time use in this manner, has not yet been available.

Social circumstances of households have considerable bearing on both the opportunities and constraints faced in making activity choices, as well as the supporting vehicle ownership and travel choices. Following is a brief discussion of some selected variables which influence the frequency, length and time of (vehicle) travel of individuals and households (data is mainly from the U.S. 1977 National Personal Transportation Survey):

Car-ownership levels - have steadily increased over the past three decades and have now reached roughly the following distribution:

	% of Households	
No. of Vehicles	Canada '82 autos only	U.S. '77 autos & trucks
0	19.9	15.3
1	52.4	34.6
2	22.4	34.4
3+	5.3	15.7
	100.0	100.0

Of these vehicles in private use, based on U.S. statistics :

93.7% are direct purchase (1/2 of them used)
3.6% company based (up to 16% of latest year models)
0.6% leased
0.1% rented
2.0% other

The initial rapid growth has almost levelled off - and it may be so far less due to the recession and the simultaneous increases in real price of fuel than due to natural (Canadian) ownership saturation levels being finally approached. What could change this emerging balance, is an economic recovery coupled with declining real prices of fuel and the availability of a new generation of cheap micro vehicles. Even without this change:

- From a theoretical productivity stand point, these ownership levels represent a significant waste capacity in the transportation system - illustrated, particularly, through the extremely low average commuting load factors and the great majority of vehicles stationary most of the day.

Number of persons, employed persons, licensed drivers, and vehicles - in a household all significantly influence both the trip rate and the vehicle kilometres travelled (Appendix F). The number of licensed drivers influences particularly strongly a household's propensity to travel - increasing the utilization rate of vehicles (in two vehicle households) by 78%, 106% and 143%, when the number of drivers increases from 1 to 2, 3 and 4+ respectively (Exhibit 2).

EXHIBIT 2

AVERAGE ANNUAL DISTANCE DRIVEN PER
LICENSED DRIVER BY NUMBER OF DRIVERS
AND NUMBER OF VEHICLES IN THE HOUSEHOLD

- Kilometres -

NUMBER OF DRIVERS	NUMBER OF VEHICLES IN HOUSEHOLD				
	1	2	3	4+	ALL
1	15152	19358	22457	25660	16473
2	12048	17269	19285	22246	16510
3	14808	13277	17047	19530	16022
4+	14307	10936	13565	16853	14793
ALL	13709	16763	17639	19340	16285

Source: 1977 NPTS
#1 "Characteristics of 1977 Licensed Drivers and Their Travel" (Table 20)

In households with equal number of drivers, the average annual distance per driver, increases significantly with increasing number of vehicles - eg. in a two driver household by 43%, 60% and 85% when the number of vehicles increases from 1 to 2, 3 or 4+ respectively. These increases, albeit large, are natural since both additional driver licenses and additional vehicles are obtained, in the first place, to satisfy latent activity demands.

- Access to additional vehicles through joining a shared vehicle fleet scheme would tend to generate additional travel by the member household drivers. Only through a reduction in each household's personally held fleet would these increases be averted.

In order to estimate the annual distance driven by shared vehicles, it is assumed (Exhibit 3) that each household would get rid of one of its own vehicles and that the driver members would maintain their original annual distances by utilizing shared vehicles for the difference. In practice, of course, significant redistribution of vehicle use might take place. Whether this shift would be toward greater relative use of household's remaining own vehicle(s) or that of shared vehicles, would depend in each instance on the:

- household's specific travel requirements
- mix of vehicles : its own fleet vs. shared fleet

- The estimated maximum annual distances per member household that would need to be accommodated by a shared fleet appear manageable and provide the opportunity to seek higher vehicle utilization rates - assuming a reasonably optimal mix of households and vehicles can be obtained.

Age and sex are other factors which very strongly influence the annual distance driven (Exhibit 4) - from a maximum of 16000 km (age group 35 - 39) to roughly 12500 km (age group 60 - 64). Trip generation rates decline also with age : household members less than 35 years of age make 0.5 more trips per day than 35 - 64 group and 2 more trips per day than 65 and over. For males, the distance driven is more than double that of females.

EXHIBIT 3

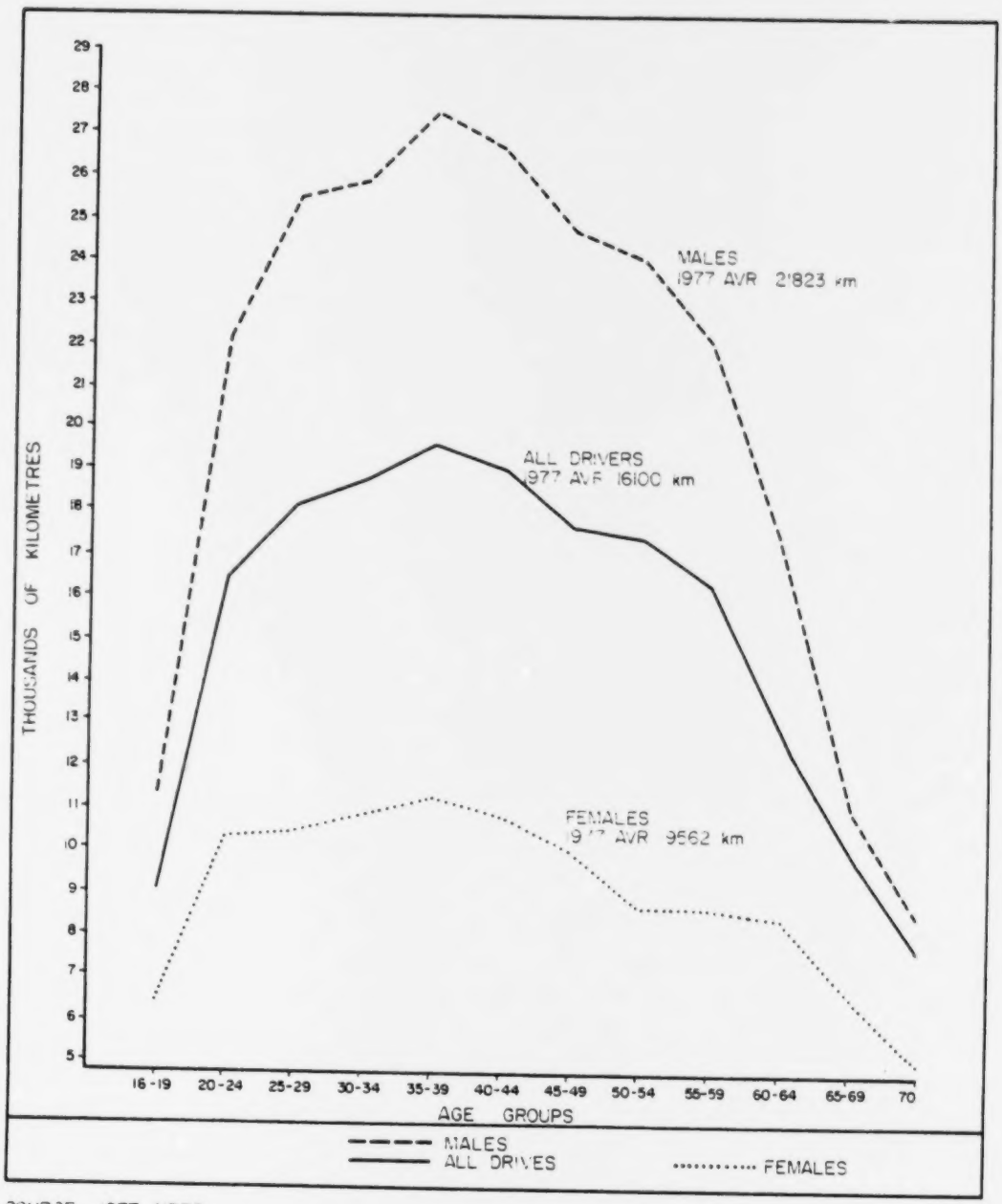
ESTIMATED ANNUAL DISTANCE DRIVEN
WITH SHARED VEHICLES
BY AN AVERAGE MEMBER HOUSEHOLD
- Kilometres -

NO. OF DRIVERS IN H/H	CHANGE IN NO. OF HOUSEHOLD'S OWN VEHICLES			
	From 1 to 0	From 2 to 1	From 3 to 2	From 4+ to 3
1	1 x 15152	1 x 4206	1 x 3099	1 x 3204
2	2 x 12048	2 x 5221	2 x 2016	2 x 2961
3	3 x 14808	3 x(-1530)	3 x 3770	3 x 2483
4+	4.3 x 14307	4.3 x(-3371)	4.3 x 2629	4.3 x 3287

Source: Exhibit 2

EXHIBIT 4

AVERAGE ANNUAL DISTANCE DRIVEN
PER LICENSED DRIVER BY AGE GROUP AND SEX
- 1977 -



SOURCE 1977 NPTS
#1 "Characteristics of 1977 Licenced Drivers and Their Travel" (Fig 3)

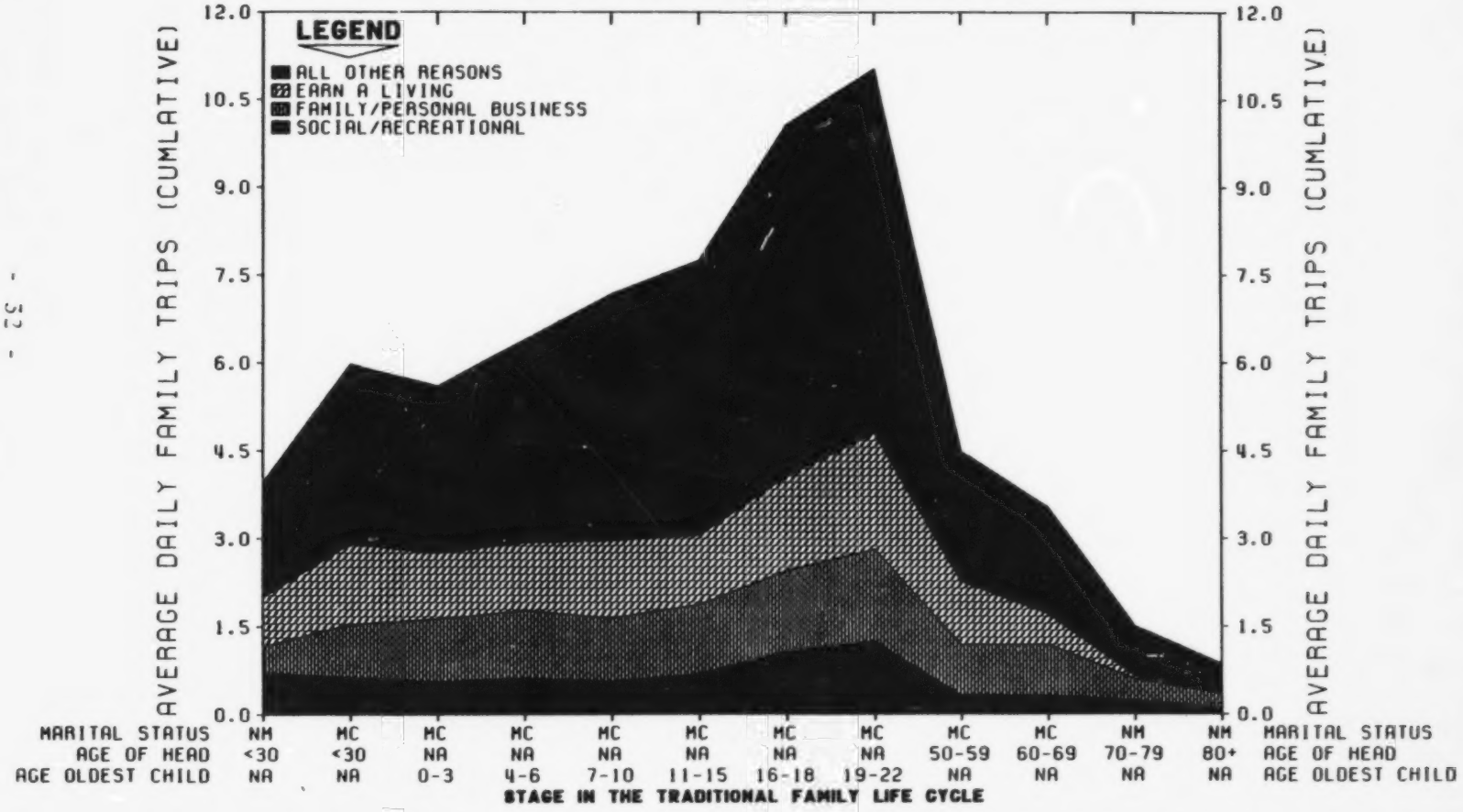
Family Life Cycle further illuminates the importance of age, and household structure, to trip making (Exhibit 5). Major break points in life cycle - eg. presence of pre-school children, presence of grown up children with drivers licenses, etc. - do signal major break points in time allocation, and therefore travel. A further description of life cycle characteristics and their impact on trip making is presented in Appendices G.1 and G.2. Current trends towards smaller households (due to reduced number of children and very high divorce rates) is likely to have an impact on both the selection of MAV's (increasingly micro/minis) and the composition of a GAV fleet. The related increases in land use densities would also, in time, tend to increase the opportunities for adopting transit (or scooter/moped/bicycle or walking) as the 'MAV' for a member household.

Another factor to be considered in the longer term is the "baby boom" generation, which will become the elderly by year 2000 - current forecasts suggest that one in five will be elderly (or handicapped, or both) by that year. However, the concept of "elderly" is very likely to have changed significantly by that time. The time of retirement will become much more flexible and, commonly, will be delayed by 4-7 years from the current average due to some very hard economic realities - people are likely to prefer (ie. demand to be allowed) to work longer to avoid facing significantly reduced retirement and other related social benefits. While these developments would seem to further support the emergence of SVF enterprises, their final impact is unclear at present.

Income has perhaps surprisingly little impact on average annual distance driven per vehicle, except for the two lowest groups (Exhibit 6). However, on a per household basis it is substantial indeed - the average distance growing with income from 12900 to 45000 kilometres. Again, these distances emerge from allocating time to various activities (at specific levels

EXHIBIT 5

AVERAGE DAILY FAMILY TRIPS BY
STAGE IN THE TRADITIONAL FAMILY LIFE CYCLE


LEGEND
ALL OTHER REASONS
EARN A LIVING
FAMILY/PERSONAL BUSINESS
SOCIAL/RECREATIONAL
AVERAGE DAILY FAMILY TRIPS (CUMLATIVE)
12.0
10.5
9.0
7.5
6.0
4.5
3.0
1.5
0.0
MARITAL STATUS NM MC MC MC MC MC MC MC MC NM NM MARITAL STATUS
AGE OF HEAD <30 <30 NA NA NA NA NA NA 50-59 60-69 70-79 80+ AGE OF HEAD
AGE OLDEST CHILD NA NA 0-3 4-6 7-10 11-15 16-18 19-22 NA NA NA NA AGE OLDEST CHILD
STAGE IN THE TRADITIONAL FAMILY LIFE CYCLE

Source: 1977 NPTS #7 "A Life Cycle of Travel by the American Family" (Fig.1)

EXHIBIT 6

AVERAGE ANNUAL KILOMETRES PER VEHICLE* BY HOUSEHOLD
VEHICLE OWNERSHIP AND ANNUAL HOUSEHOLD INCOME

Household Vehicle Ownership	Less than $5,000	$5,000 to $9,999	$10,000 to $14,999	$15,000 to $24,999	$25,000 to $34,999	$35,000 to $49,999	$50,000 or More	All Income Groups
Average Annual km Per Vehicle	11350	14478	16510	17432	18146	18906	18660	16392
Average Annual km Per Household (all households)	7186	10611	25720	34384	40830	43076	44273	24232
Average Annual km Per Household (vehicle owning households)	13382	20111	27507	35411	41495	44500	45546	28608
Percent of Vehicles	8.4	17.1	22.5	32.7	12.0	4.8	2.5	100.0‡

* Includes all motor vehicles (autos, trucks, motorcycles and mopeds) owned by or available to the household on a regular basis.
‡ Total vehicles = 107,900,000 (120,098,000 less 12,198,000 for which annual miles not reported).

Source: 1977 NPTS
#5 "Household Vehicle Utilization" (Table 3)

of exclusivity) and are an expression of chosen life styles.

- Each of the above factors has a strong impact on the frequency, time and distance of individual and household travel - and, therefore, on the degree of convenience and practicality of that household joining a shared vehicle fleet scheme.

  Perhaps more importantly, these factors influence the general attitudes of households and individuals toward joint ownership type schemes.

Trip purpose (or activity choice) is an important factor in determining the constraints and opportunities for using shared vehicles, ie. the extent to which a trip is nondiscretionary or discretionary, mainly in terms of a time (and day) of travel. "Earning a living" category, roughly 38% of all travel (Exhibit 7), is not only the least discretionary, but also tends to render a vehicle useless (= parked) for the working hours. However, there are two possible techniques of overcoming this situation :

- o by joining a car/van/bus pool or by commuting by transit some vehicles can be "released" for possible joint use (71% of Canadian auto commuters currently drive alone); and,

- o company shared fleets, where vehicles used for commuting by selected employees or employee pools are made available to all employees for work related travel during the day.

- Both of these techniques can be most important in "squeezing" extra productivity out of vehicles otherwise stationary.

Vehicle occupancy is another indicator of the flexibility that trip makers may have for utilizing shared vehicles. During weekends, average occupancies rise significantly for all purposes (Exhibit 8) - complicating for their part the advance reservation requirements just when typical weekend usage patterns can also narrow the practical availability of shared vehicles.

EXHIBIT 7

DISTRIBUTION OF VEHICLE* TRIPS BY TRIP PURPOSE AND NUMBER OF OCCUPANTS

	TRIP PURPOSE														
	Earning a Living			Family and Personal Business				Civic Education Religious	Social and Recreational					Other and Unknown	All Purposes
Number of Occupants	To Work	Work Related	All	Shopping	Medical Dental	Other	All		Visit Friends & Relatives	Pleasure Driving	Vacation	Other	All		
Single Occupant	83.7	80.1	83.0	50.5	42.7	60.3	54.5	50.2	48.8	26.8	11.0	34.3	40.5	43.3	59.9
Multi Occupant															
2	12.0	13.7	12.3	31.2	38.4	25.6	29.0	27.0	29.4	37.2	60.0	36.7	33.5	33.1	24.7
3	2.9	3.8	3.1	10.5	10.4	8.0	9.4	10.4	11.4	16.6	1.3	12.3	12.0	13.2	8.2
4	0.9	1.3	1.0	4.6	5.6	4.1	4.4	7.0	6.7	11.0	3.3	10.1	8.6	6.0	4.4
5	0.3	0.5	0.3	2.2	2.0	1.4	1.8	3.1	2.2	4.6	14.1	4.0	3.2	2.3	1.7
6 or More	0.2	0.6	0.3	1.0	0.9	0.6	0.9	2.3	1.5	3.8	10.3	2.6	2.2	2.1	1.1
Subtotal	16.3	19.9	17.0	49.5	57.3	39.7	45.5	49.8	51.2	73.2	89.0	65.7	59.5	56.7	40.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0†
Percent of Vehicle Trips	27.8	5.1	32.9	17.0	1.3	14.0	32.3	6.4	8.4	0.4	0.1	10.4	19.3	9.1	100.0‡
Percent of Vehicle km	30.4	7.3	37.7	10.0	1.7	11.2	22.9	4.7	11.3	0.8	0.6	11.3	24.0	10.7	100.0**
Average Trip Length (km)	14.8	19.1	15.4	7.9	17.4	10.8	9.5	9.8	18.0	25.3	153.5	14.6	16.4	15.8	13.4

* Includes all private vehicles except motorcycles and mopeds.

† Total vehicle miles of travel - 902,755,000,000 (907,603,000,000 less 4,848,000,000 by motorcycles and mopeds).

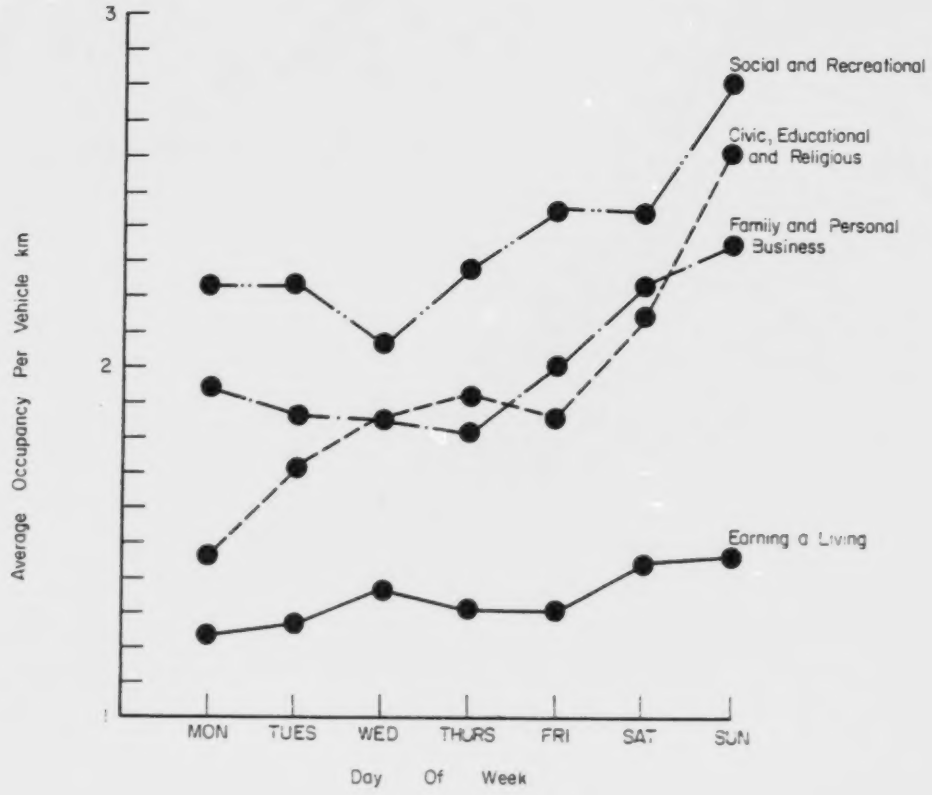
‡ Total vehicle trips - 108,430,000,000 (108,826,000,000 less 396,000,000 by motorcycles and mopeds).

**From Table I

Source : 1977 NPTS
#6 "Vehicle Occupancy" (Table 3)

EXHIBIT 8

AVERAGE OCCUPANCY BY DAY OF WEEK AND TRIP PURPOSE



Source 1977 NPTS
6 "Vehicle Occupancy" (Fig 3)

- The variety of trip purposes and their degree of discretionarity (time and day of travel) - combined with the number and type of the prospective households' current vehicles - present, at the same time, a complex challenge for the design of a specific shared vehicle fleet scheme and an opportunity to significantly increase the utilization rates of both the household and shared fleets.

- Estimates for the % share of distance travelled - that could be served, in reasonable comfort, by a micro type vehicle (as the average household's MAV) - vary from 45% to 90% depending on the assumptions about the current structure of the household's typical daily vehicle 'tours', including the extent of trip chaining and the vehicle occupancy within each section. Seventy percent may be a reasonable average estimate.

3.3 Alternative Work Schedules

Staggered hours, flexihours, and various forms of compressed work week - eg. "9 out of 10", 4½/4/3½/3 day weeks - are gaining increasing popularity in most sectors of the economy. Their influence, combined with the electronic communications revolution, will be to significantly modify people's time allocation, affecting particularly the time expended for work related travel - eg. 4-day work week alone will reduce commuting travel by 20%, assuming no changes in home/work relative location. With "9 out of 10" (any one day off during a 2 week period) and a flexible 4 day work week, discretionary travel flexibilities are substantially increased - while travel needs are reduced.

- To shared vehicle fleet schemes, the emergence of alternative work schedules presents a most important opportunity for increasing vehicle utilization rates - thereby reducing the necessary fleet size and distance/time rates charged to members.

3.4 Implications of the Trends

Based on our review, there are three main factors for which recent trends seem to give some indication of the

opportunities for possible near term formation of shared vehicle fleets in Canada:

1. Expenditures of average household will stay in a tight economic squeeze for the foreseeable future, even with a temporary decrease in real price of oil - with two possible relevant consequences:

   a) Perceptions about day-to-day vehicle operating costs may change to include annualized fixed costs;

   b) The transportation component's relative (%) share could decline significantly (1-2.5 percentage points)

2. Alternative work schedules, in combination with telecommunications developments, will provide a significantly increased flexibility for both discretionary and non-discretionary travel.

3. The reducing size of average households and the increasing number of elderly will, over time, increase the proportion of households which can get adequately by with one or no personally owned vehicle.

The implications of these developments for shared vehicle fleets may be interpreted as follows:

- Innovative (shared vehicle fleet) schemes which provide a chance for households and individuals to:

  - reduce transportation expenditures; but also to

  - retain much of conventional transportation accessibility,

  can be expected to be of interest to at least some population segments.

- The sizes of shared vehicle fleets can be optimized (for maximum cost-effectiveness) by increasing the utilization rates of both joint and personal fleets.

The other household related factors reviewed, ie:

- o car ownership
- o number of licensed drivers, their age and sex
- o family life cycle
- o income and life style

each have a significant impact on the frequency, time and duration (length) of vehicle travel. When the greatly varied activity types - and their locations, times (and dates) and durations - of member households and individuals are considered together with possible combinations of vehicle types in the households' personal and shared fleets, the full (theoretical) complexity of seeking to establish an optimal scheme may be appreciated. The complexity is such, in fact, that any "comprehensive modelling" approaches - however analytically challenging and potentially eloquent - would not be very useful. However, the development of a "skeleton logic flow" - depicting the basic interrelationships between socio-economic and travel trends, and vehicle ownership/usage levels of individual households - would be helpful in selecting which schemes might most appropriately be included in the surveys and subsequent demonstrations.

In the end, the propensity of any household to join a shared vehicle scheme will depend in an intricate way on all these factors, the household's specific circumstances and attitudes - and, of course, on the specific scheme being marketed.

4. RESEARCH AND DEVELOPMENT PROGRAM DEFINITION

The State-of-the-Art Review (Chapter 2) indicated three important developments in shared vehicle fleet experiments:

- o past experiments on using such schemes as CBD circulation systems had met with clear failure;
- o a gradual shift had started toward presidential based small scale experiments and other previously untested innovative schemes; and
- o the recent renewed interest has resulted in important major demonstrations - particularly in Sweden and the U.S.

A literature search and discussions with selected experts in the field were undertaken to identify current projects that would involve the major issues related to the implementation of SVF. No directly relevant research results have become available during the course of this study. However, this area should be continued to be monitored for any results that might be helpful in the subsequent development of demonstration activities.

The brief Review of Relevant Socio-Economic Trends (Chapter 3), suggests a significant (theoretical) opportunity for implementing shared vehicle fleet schemes in Canada - mainly due to:

- o the economic pressures for households to reduce the transportation component of their budgets;
- o the significant time/space flexibilities in discretionary travel and the increased flexibilities in all travel from the expected alternative work schedule and communications developments; and
- o the increasing proportion of households which can get adequately by with one or no personally owned vehicle - resulting from the reduced size of average households and the increased number of elderly.

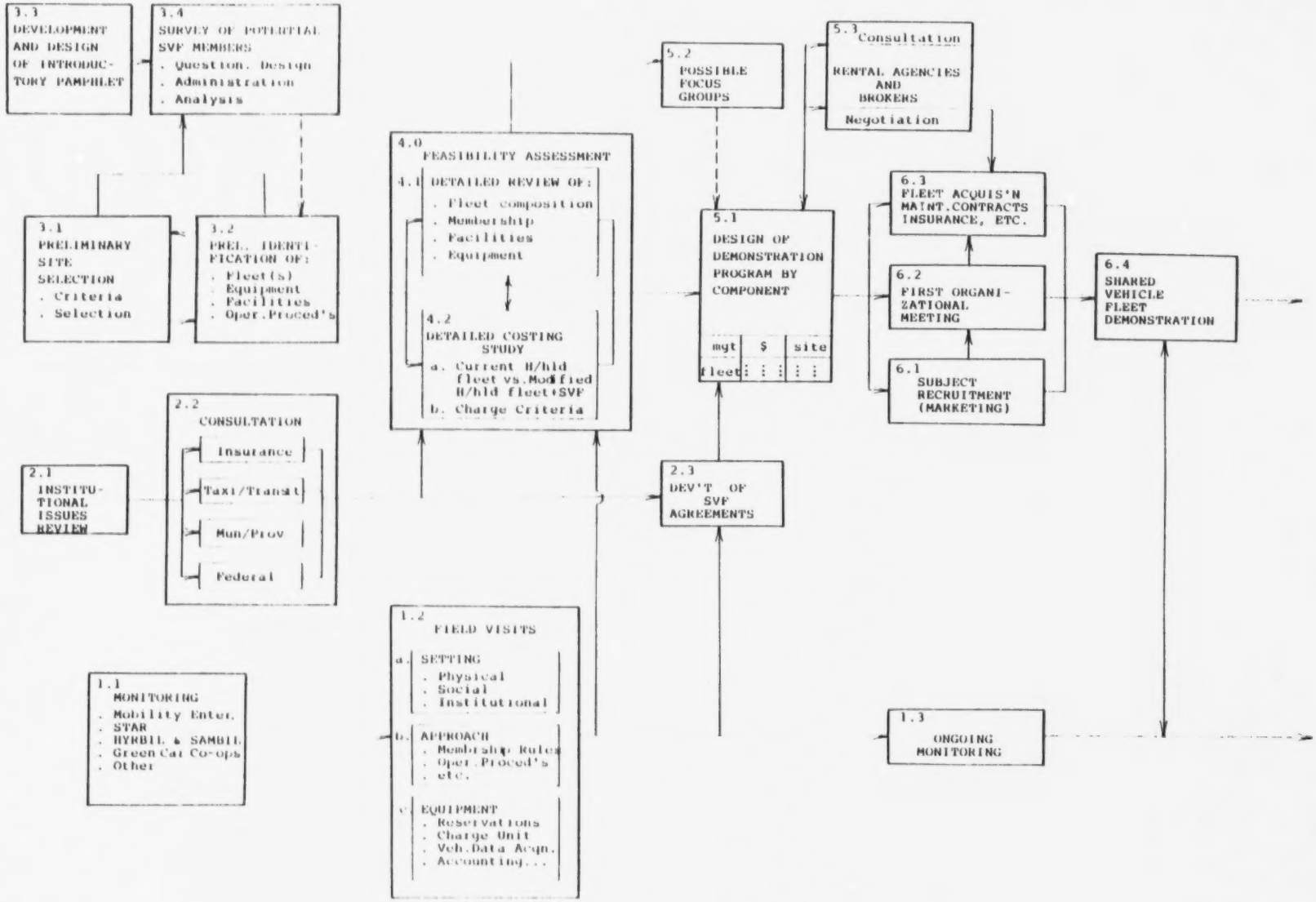
It is important to recognize that - while these opportunities appear significant - they are, at this point, only

theoretical. Because of the immense complexibity of modelling consumer behaviour in this intricate attitude/behaviour vs. cost savings trade-off environment, only the implementation of a carefully developed demonstration program will establish the true propensity of (some) Canadian households to join, and continue to participate, in shared vehicle fleet schemes.

A preliminary program for advancing the implementation of shared vehicle fleet schemes in Canada is presented in point form in the following (for a diagram, see Exhibit 9):

EXHIBIT 9 : SHARED VEHICLE FLEET CONCEPTS

Research, Development & Demonstration Program - Diagram



Step 1 ESTABLISH A MONITORING PROGRAM

1.1 Monitor the progress of current and emerging experiments in shared vehicle fleet type schemes:

- Mobility Enterprise (Purdue University)
- Short Term Auto Rental (STAR by UMTA)
- Hyrbil and Sambil (Sweden)
- Green Car Co-operatives (England)
- Others

1.2 Field visits to selected demonstration sites to review:

a) Settings: physical/social/institutional

b) Approach: membership rules/operating procedures/ ..

c) Equipment: fleet composition (MAV's + GAV's)/ reservation and charge units/accounting and data storage/..

Identification of component research required in support of Canadian demonstration & development of specifications

d) Development of vehicle specifications for MAV's and GAV's

1.3 Ongoing monitoring - with a brief progress report every 3-4 months :

- shared vehicle fleet concepts
- related travel behaviour/.. research (highly selective basis only

1.4 Develop sketch planning technique (skeleton logic flow) for estimating the (theoretical) demand for SVF enterprise services in an area.

Step 2 INSTITUTIONAL ISSUES REVIEW

2.1 Review relevant institutional impediments and opportunities for establishing joint ownership/usage schemes.

2.2 Consult the following about the details:

- insurance companies : current rules, coverage and representative costs for different schemes, eg. regular households, businesses (with and without weekend employee use), disabled groups,..
- taxi and transit operators: competitive considerations
- sample municipalities and all provices: licencing

and regulations
- federal gvt: regulations (eg. crash test requirements for micros,..) and taxation (possible incentives)

2.3 Develop specific shared vehicle fleet agreements

- membership and enterprise binding legal agreements
- wordings for proposed legislative/regulatory/insurance changes
- taxation measures and other incentives (eg. municipal parking,..)
- enterprise back-up contracts: taxi company/..
- combined with parcel delivery

Step 3 PRELIMINARY SITE SELECTION AND SURVEY

3.1 Develop criteria for preliminary site selection:

- central city vs. outside central city vs. satellite community
- medium/high density vs. other
- fair to medium access to transit vs. other
- medium average incomes vs. mixed vs. other
- degree of ethnic and cultural mix
- closeness to commercial subcentre or industrial park
- available parking/garage/maintenance facilities
- availability of - vehicle rental agencies
  - independent transportation brokers

Select metropolitan area and the specific local or satellite community.

3.2 Preliminary identification of - fleet (MAV's + GAV's)
- equipment
- facilities
- operating procedures

3.3 Develop and design an introductory pamphlet for shared vehicle fleets - to be used in the survey(s) and as handout for public relations (if required) :

- SVF concept description and summary of main advantages
- typical membership requirements and legal agreements
- service definitions and operating procedures
- user charges - time/distance basis
  - estimated rate for demonstr. period
- etc., as appropriate

3.4 Survey of potential SVF enterprise members

a) Questionnaire design (for main content, see Exhibit 10)

EXHIBIT 10

SURVEY OF POTENTIAL SVF ENTERPRISE MEMBERS

- Preliminary Questionnaire Content -

DEMOGRAPHICS	- Member age/sex (family life cycle) - Driver licence/employment status
RESIDENCE	- Residence type and past frequency of moving
VEHICLE OWNERSHIP	- Number/type/age/current mileage - Expected "renewal" date and type
TRAVEL PATTERNS & MODE CHOICE	- Work (& college/university) locations and distance - Shopping locations: groceries/other - Recreation: weekend local/cottage/vacation - Social/personal business - Flexibilities in the above (eg. due to work hours) - Vehicle occupancy
SHARED VEHICLE FLEET	- Initial reaction (based on pamphlet and interviewer's presentation) - Desirable attributes - vehicle type(s) - on board equipment - new/2-year old used - Price threshold for considering/agreeing to join an enterprise
POSSIBLE SVF USAGE	- Frequency - Day and time - Purpose - Distance . with personal fleet as is . with one less own vehicle (if conceivable)
ENERGY PERCEPTIONS	- Transportation price consciousness: perceived usage cost vs. total usage cost - Share of household budget - Own criteria for vehicle purchase (factors & relative weights) - Recent changes: modal shift/less trips/more efficient car/...

b) Administration of questionnaire : personal interviews 80 - 240 households

c) Analysis : cross-tabulations of household type/ other variables to identify
- innovative consumers
- initial reactions & desirable/absolute attributes
- anticipated SVF usage
- etc.

Step 4 FEASIBILITY ASSESSMENT

4.1 Detailed review of :

- current fleet composition of potential member households
- suggested SVF characteristics and needed availability
- size & type analysis (ie. validity of MAV/GAV concept)
- anticipated utilization rates

Review of vehicle types to include:

- large sedans
- vans
- station wagons
- standard/compact/ sub-compact cars
- jeeps
- other recreational vehicles
- small trucks
- micro/mini cars
- motorcycles/scooters/mopeds

Review of on-board equipment to include:

- stick shift vs. automatic transmission
- power steering & cruise control
- air conditioning
- trailer hitch
- special controls :
  - maximum speed governor
  - tachograph, for monitoring usage roughness
  - enterprise charge unit for inserting I.D. card

4.2 Develop detailed costing study for two basic management concepts: 1) Rental agency based
2) Independent transportation broker based

a) Comparisons to be made between two fleet systems available to the prospective households:

- current personal fleet
  vs.
- modified/reduced personal fleet + shared fleet

Cost components must be based on most recent data and include:

- financing charges: capital cost & amortization
- anticipated resale value: low estimate discounted
- interest revenue on first and last months' member security deposits
- operating costs
  - licencing & registration
  - insurance: individual+group
  - garaging & parking
  - maintenance
    - . scheduled preventive
    - . unscheduled (estimated breakdowns)
  - day-to-day mgt.
    - . facilities
    - . equipment
    - . personnel
- assumed usage rate for each vehicle
- any cross-subsidy from peak to off-peak usage

Specific analysis for documenting the costs of owning a 'compromise' vehicle (which is not optimal to most trips), and the costs of owning an under-utilized second, third or specialty vehicle (this data essential for marketing purposes).

b) Develop criteria by which the total costs and charges are applied to each rental of each vehicle; include following components:

- distance driven
- time held outside enterprise's garage (or in/out recording device)
- gasoline purchased (will require a tamper proof method)
- any unexpected maintenance expenses (eg. towing, quick charge of battery, etc.)
- time period when vehicle taken out/brought back in/held (within a day, week or season)
- and possibly:
  - return delay penalties (when others waiting)
  - failure to pick up penalties (when others had attempted to reserve same time slot)
  - vehicle interior/exterior extra cleaning penalties
  - rough handling penalties (abrupt & high speed)

Step 5 DESIGN OF DEMONSTRATION PROGRAM

5.1 Design of the demonstration program by component

- management
- funding

- final site selection
- membership rules and restrictions
- fleet composition
- parking and garaging
- maintenance contracts
- insurance (liability agreements)
- detailed operating procedures . service definitions
- support equipment . charge system
  . .....
  - reservations system
  - charge unit
  - vehicle data acquisition system
  - accounting and management (micro computer decision)
  - final diary and other forms
  - etc.
- etc.

5.2 Possible use of focus group(s) to refine the shared fleet characteristics and operating procedures (in support of Task 5.1)

5.3 Rental Agencies and Brokers

- Consultation to review proposed operating plan in detail and to evaluate agency/broker interest and capability for taking the responsibility for the demonstration program.

- Negotiations on detailed broker/enterprise/federal government operating agreements.

Step 6 INITIATION OF THE DEMONSTRATION

6.1 Marketing of the SVF enterprise in the area(s) selected: subject recruitment

6.2 First organizational meeting: membership/broker/government - final review/approval for Task 6.3

6.3 Fleet acquisition based on the costing study (4.2), negotiations (5.3) and the degree of success in marketing (6.1)

Corresponding arrangements and agreements for maintenance contract, garaging (if any) and insurance (enterprise and membership).

6.4 The shared vehicle fleet demonstration, operation, monitoring and fine tuning.

Frequent management reports on the general progress and on the cost-revenue performance.

There are four basic alternatives for considering the shared vehicle fleet development and demonstration program outlined above:

1. Do nothing
2. Establish a monitoring program only (Step 1)
3. Proceed one step at a time (as separate projects)
4. Undertake the full program in two phases:
   Phase I : Steps 1-5
   Phase II : Step 6

It is recommended that funding, to cover Steps 1 through 5, be sought and that authorization be given to proceed with these steps - either in alternative three or four fashion (depending on administrative ease or other factors).

A detailed outline for undertaking Step 6 should be developed during the course of Phase I.

APPENDICES

APPENDIX A

P R O C O T I P

- Summary Description -

Historically, the first significant experiment with the joint use of a common group of vehicles by different parties began in 1971 in Montpellier, France (pop. 200 000). The initial stimulus for this project was the invention of a metering device that could recognize a particular type of circular plastic token and could mutilate its circumferential edge in proportion to the distance travelled. The basic strategy was to equip a fleet of small automobiles (Simca 1000's) with this meter and have these vehicles located strategically around the city for the use of subscribers to the private cooperative which owned them.

The plastic tokens represented a simple and innovative way of allocating the cost equitably among the members without the cumbersome problems of keeping records, billing, and so on. The tokens were bought from the cooperative, and these revenues, along with a periodic membership fee, were intended to cover costs. Within a very short time the project attracted over 300 members and grew to 35 vehicles with 17 reserved parking sites (provided by the municipal authorities) throughout the city.

After only 18 months of operation, the project declared bankruptcy for what now seem obvious and readily understandable reasons. The following factors were significant in the ultimate demise of the system:

- o Service Area - The area being compact, the climate good, and walking as the dominant mode of transport, limited the potential market for shared vehicle schemes
- o Congestion - The street network was ill-suited for vehicular flow and the PROCOTIP vehicle was subjected to the same congestion as other non-walk modes.
- o Parking - Abuse of parking regulation at terminals was common, thereby removing the advantage of a readily available space.

- Charges - Charges to the user were based upon mileage alone, with no penalty for prolonged periods during which the vehicle was not in use. The user charge per mile was about as high as could be assessed in order to remain competitive with other modes but did not approach actual costs.

- Vehicle Availability - With a maximum of 35 vehicles at 17 stations and some vehicle hoarding (particularly with no time charge), the probability of a vehicle being available when and where needed was low.

- Market - The users tended to be of a middle and upper income level where everyone had one car, and the PROCOTIP system served to replace the need for a second car.

- Equipment - The vehicle offered no significant environmental advantage and mechanical difficulties with the TIP meter caused difficulties in the early phase of the service period: some users being stranded, or charged excessive or inadequate fare with subsequent vehicle down time.

- Scale - The scale of operation was very small with insignificant impacts.

- Management Practices - There was a significant lack of advance planning in terms of site selection, financial management (including simple record keeping) and marketing.

Source: Ref. 1 (Chapter III)

APPENDIX B

W I T K A R

- Summary Description -

Amsterdam, with a city population of nearly one million people and a regional population of approximately two million.was the scene of the next major experiment in CBD circulation system type shared vehicle schemes. The inner area of Amsterdam is a national treasure of pre-19th century structures, built around a series of semi-circular canals. This area comprises about 3.2 square miles with a mix of shopping, office, and University activities, as well as a resident population of 70 000. The area is well serviced by public transportation with a very high usage of bicyles and pedestrian ways. The inner area suffers from a high degree of traffic congestion and an accute shortage of available parking. It is estimated that on a normal day there are 30 000 parked cars in the inner core, 10 000 of which are illegally parked. The manner in which every available space is used for parking demonstrates the adverse impact of private automobile use in the city. The Witkar system was intended to serve trips within the inner area which are too long for walking. It was planned to meet the needs of people living within the area and those who arrived by transit and were without an automobile as well as those arriving by car, but not using it for internal trips because of the severe shortage of parking. Several factors characterizing the Witkar experiment are significant:

- o Service Area - As in Montpellier, the prime competitor of the Witkar was walking, so that Witkar was never likely to substantially reduce traffic congestion.
- o Congestion - Witkar did not operate in an ARZ (auto restricted zone) environment and thus was subject to the same severe local street congestion experienced by conventional automobiles.
- o Parking - Parking space at destination was checked by attendants (then computers) to insure availability prior to departure. Parking restrictions at stations were enforced (no entry by conventional vehicles).

- o Charges - Charges based upon time seemed to work out more satisfactorily than the experience that PROCOTIP had with distance. With installation of computer control, a flexible fare schedule including time and distance charges, peak-hour pricing, and reduced charges for trips to destination terminals with depleted vehicle stocks, was planned.

- o Vehicle Availability - The redistribution procedures were based on an informal program of redistribution by volunteer attendants at days'-end, a procedure that would have soon become more complicated as the system expanded.

- o Equipment - The vehicles were plagued with mechanical breakdowns in the early stages of operation. Several improvements were accomplished through design changes. The vehicles are attractive, quiet, non-polluting, and well-suited for their intended role (albeit, in a different application).

- o Scale - The scale of operation was too limited to identify any significant impacts. The scale of operation and the level of volunteer help do easily distort assessment of its true financial feasibility.

Source: Ref.1 (Chapter III)

Figure 1

WITKAR SPECIFICATIONS

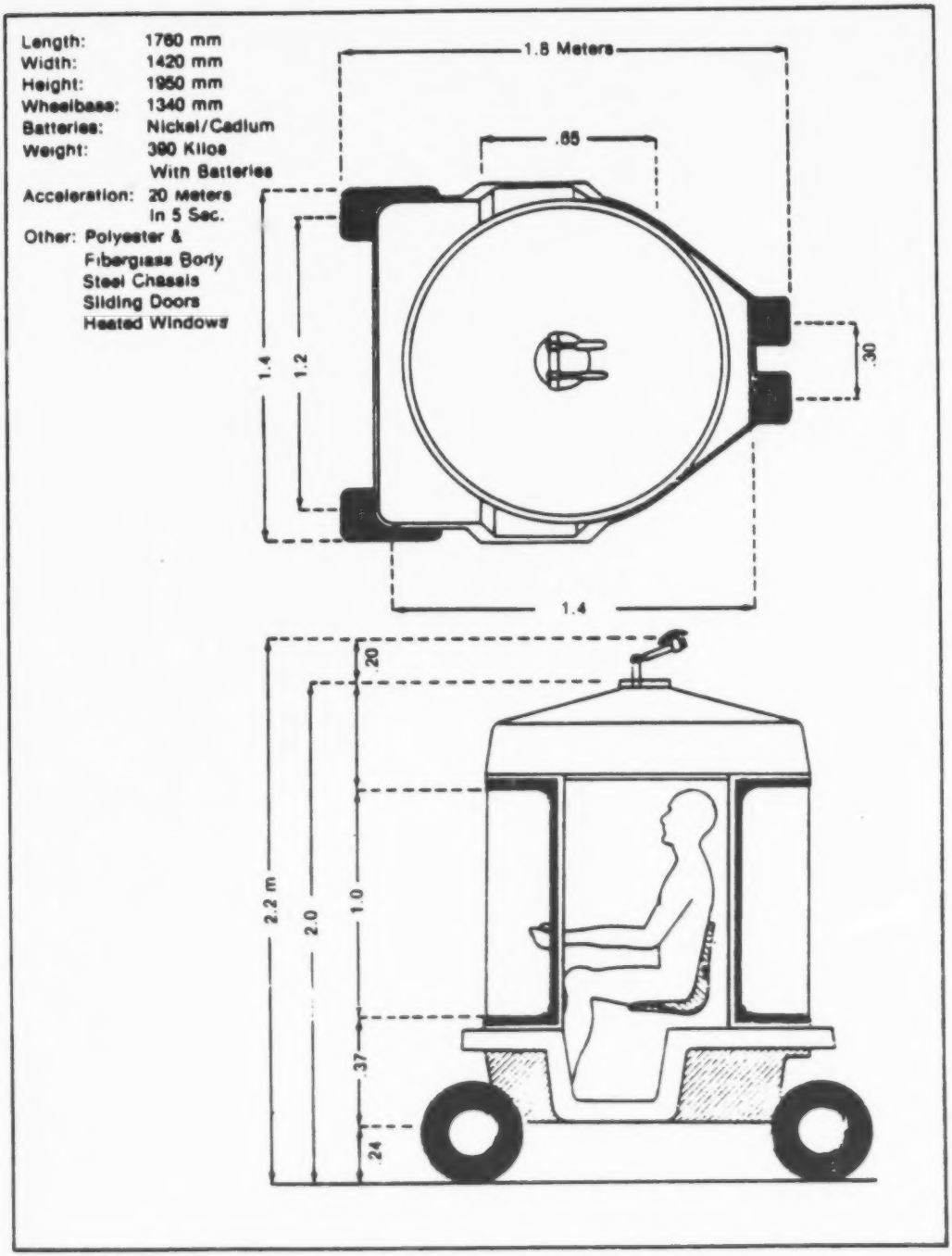
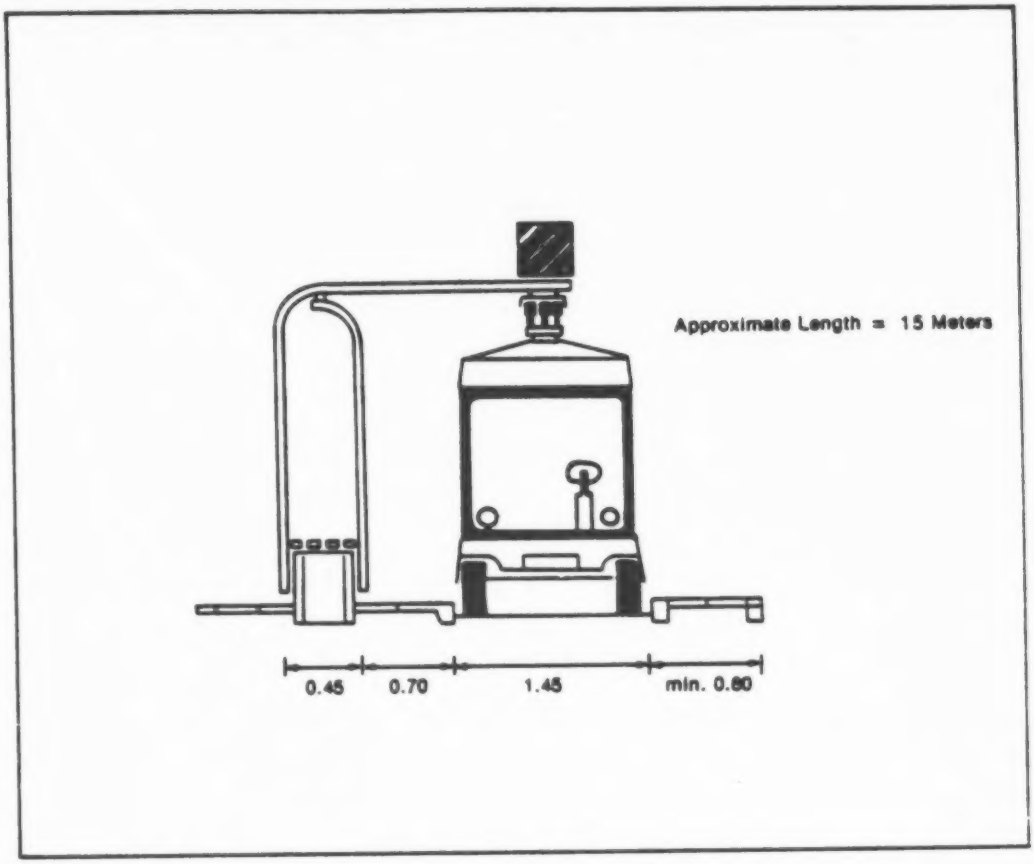


Figure 2

WITKAR STATION DIMENSIONS



APPENDIX C

THE PURDUE MOBILITY ENTERPRISE

- Summary Description -

TABLE 1 : PROVISIONS FOR A SET MONTHLY FEE

- o an individually garaged mini/micro which will satisfy most commuting and "around town" driving.
- o access to a shared fleet of intermediate and full-sized vehicles for trips which the mini/micro would be unsuitable or unavailable
- o included in the fee would be:
  - all insurance costs
  - all maintenance costs
  - all registration and licencing costs
  - taxes
- o gasoline costs are NOT covered in the monthly fee
- o cost per participating household during the experiment will be $140 - $180 per month.

TABLE 2 : COMPARISON OF AUTO OWNERSHIP ALTERNATIVES

Alternative	Vehicle Type and Price	Ownership Costs	Operating Costs	Miles Driven	Total Annual Cost
I	$8100 GAV	$1851	$.18/mi	10 000	$3656
	$3800 MAV	$ 626	$.13/mi	7 000	$1512
II	$8100 GAV (.4 veh./member)	$ 757	$.18/mi	3 000	$1280
	Alt. II totals (per member)	---	---	10 000	$2792

TABLE 3 : TOTAL VEHICLE EXPENSES--MAJOR COMPONENTS

	GAV	MAV
Purchase price	$ 8 100.	$ 3 800.
Value after 4 years	4 133.69	3 249.58
Average miles per year	10 000	7 000
Average mpg	25	45
Annual payments (2)	2 607.62	1 223.33
Annualized present worth of resale	756.70	596.81
Annual gasoline ($1.40/gal.)	560.	217.
Maintenance (1)	688.70	370.72
Insurance (1)	555.96	297.96
Total Annual Cost (3)	3 655.58	1 512.20
Total 4-year Cost (3)	14 622.32	6 048.80

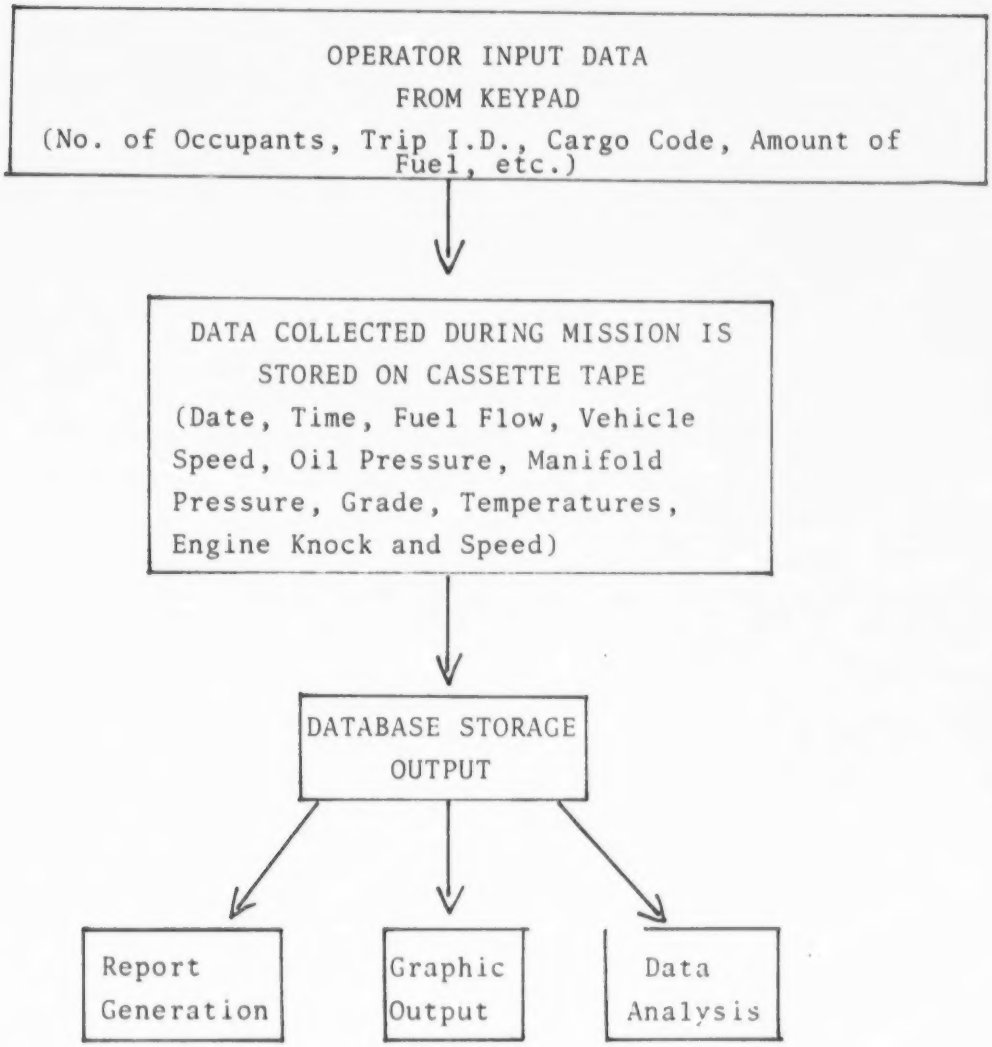
(1) Maintenance and insurance costs for $3000 vehicle are $0.05/mile and $250/year, respectively. These values increase linearly with purchase price.

(2) Interest rate = .13

(3) Includes depreciation

Figure 1

FLOWCHART OF DATA ACQUISITION SYSTEM


OPERATOR INPUT DATA
FROM KEYPAD
(No. of Occupants, Trip I.D., Cargo Code, Amount of Fuel, etc.)
DATA COLLECTED DURING MISSION IS STORED ON CASSETTE TAPE
(Date, Time, Fuel Flow, Vehicle Speed, Oil Pressure, Manifold Pressure, Grade, Temperatures, Engine Knock and Speed)
DATABASE STORAGE
OUTPUT
Report Generation
Graphic Output
Data Analysis

APPENDIX D

S T A R

- Summary Description -

THE PROJECT

The project's purpose is to rest the concept of shared use of automobiles by incorporating a short-term auto rental (STAR) function into the operations of a large apartment complex. Individuals would select an automobile correctly sized for their trip distance and purpose. The end objective is to reduce the cost of automobile use or to relieve the apartment dweller of the need to own an automobile, and to reduce related energy consumption.

The project has been divided into three phases: feasibility/design/implementation.

DEMONSTRATION SITE

Apartment complex in San Francisco central city - 9,000 residents, low/medium/high income mixed development.

BASE SYSTEM

The cars are located at the central site: all the apartment dwellers walk to this central point to pick up cars. The single location is necessary in order for one attendant to keep cars cleaned and fueled. An attendant, on duty for 16 hours per day, 7 days a week, works in a small transportation booth. Immediately nearby is a gasoline pump and a one car wash room. Inside the booth is either of two systems:

1. A fully manual system of "people" cards on which data are written on each car usage -- car type, mileage out and in, time out and in. A time punch clock is needed. This historical record later becomes the monthly invoice.

2. The same process is accomplished via a micro-computer with built-in clock that records the individual records of each user.

Both systems must keep track of what cars are available.

To obtain a car the user approaches the booth, asks for the car type of his/her choice, is given the key, is clocked out, and leaves. On return he/she parks at the booth, is clocked in, the attendant records the mileage, and attendant or user parks the car and locks it.

When sufficient mileage is recorded on a car the attendant, between customers, puts in gasoline and gives the car a quick clean out. Possibly once every three days the attendant washes the car. Every three months the attendant takes the car in for servicing at a nearby service station, probably returning to the booth on a bicycle he/she carries in the car. This is probably done at the end of a shift when the second shift attendant has come on duty.

Users can call the booth and reserve a car in advance, gaining certainty that the desired car size will be available.

In addition to the booth, there is a central accounting office. The central office handles the basic administrative functions -- bill paying, invoicing, payment receiving, and fleet size management. Customer problems are handled at the booth or, when necessary, referred to the central office. Registered customers are invoiced monthly with a telephone-like record of trips taken. The rental charge is based on minutes rented and miles driven and covers all costs, including insurance and gasoline.

APPENDIX E.1

SUMMARY OF FAMILY EXPENDITURE, BY FAMILY INCOME
16 CITIES, CANADA, 1978

- All Families and Unattached Individuals -

		Family income - Revenu de la famille				
		All classes - Toutes categories	Under $6,000 - Moins de $6,000	$6,000 - 7,999	$8,000 - 11,999	$12,000 - 15,999
	Family characteristics					
1100	Number of families in sample	5,114	482	314	586	579
1101	Estimated number of families	3,473,900	300,010	213,000	387,350	484,600
	Average					
1102	Family size	2.75	1.33	1.96	2.00	2.29
1103	Number of children under 5 years	.19	.06	.08	.15	.16
1104	Number of children 5 to 15 years	.51	.08	.27	.28	.37
1105	Number of adults 16 and 17 years	.10	.01	.05	.07	.06
1106	Number of adults 18 to 64 years	1.79	.60	.85	1.18	1.61
1107	Number of adults 65 years and over	.23	.60	.75	.37	.17
1114	Number of full-time earners	.89	.01	.12	.46	.71
1115	Age of head	45.0	58.6	56.2	46.0	42.6
1116	Income before taxes	21175.1	4176.3	6957.5	9994.6	13972.4
1117	Other money receipts	748.1	478.8	473.7	338.0	607.0
1118	Net change in assets and liabilities	1563.8	557.6 -	434.2 -	223.9 -	117.4
	Percentage					
1120	Homeowners	51.9	26.5	30.5	27.6	30.1
1121	Car or truck owners	72.3	17.5	39.0	51.9	67.3
1127	With head Canadian born	68.0	63.1	62.6	73.7	72.1
1128	With spouse employed full time	17.3			1.2	6.0
	Average dollar expenditure					
1-12	Food	3344.7	1380.0	1939.7	2241.0	2732.1
20-128	Shelter	3429.2	1647.6	2134.1	2409.1	2754.3
20-23	Rented living quarters	1191.4	1078.9	1417.3	1546.2	1671.9
30-105	Owned living quarters	1504.7	263.5	321.0	440.0	593.8
110-119	Other accommodation	192.9	17.4	36.3	70.1	111.8
120-128	Water and fuel and electricity	540.1	287.8	359.6	352.8	376.8
130-197	Household operation	814.6	322.1	434.9	537.2	652.8
200-349	Household furnishings and equipment	868.1	196.9	286.7	390.9	507.9
200-230	Furniture	299.5	67.7	84.5	114.7	209.1
240-274	Household appliances	170.9	41.0	68.9	97.0	126.9
280-349	Other	397.7	88.2	133.3	189.1	271.9
360-641	Clothing	1369.5	276.3	502.3	677.9	922.4
650-692	Personal care	336.4	113.9	175.2	214.5	266.4
700-740	Medical and health care	391.2	105.0	171.2	246.3	331.7
750-781	Tobacco and alcoholic beverages	641.9	198.6	327.2	409.2	503.2
790-844	Transportation	2334.8	294.1	728.4	1125.4	1917.8
790-818	Automobile and truck	1974.7	164.1	513.8	867.9	1500.7
790-791	Purchase	907.7			319.8	684.1
800-818	Operation	1067.0	125.6	318.6	548.1	816.6
820-844	Other transportation	360.2	130.0	214.6	257.5	317.1
850-922	Recreation	979.8	234.1	304.2	447.3	548.4
930-936	Reading	121.9	51.2	63.9	82.6	96.9
940-951	Education	150.1	60.5	71.5	84.3	83.0
960-971	Miscellaneous expenses	448.9	118.6	154.3	224.3	375.9
1-971	**Total current consumption**	**15231.1**	**4999.1**	**7293.7**	**9089.9**	**11892.8**
980-981	Personal taxes	3713.1	56.5	222.2	945.6	1844.5
985-991	Security	914.5	36.4	94.9	306.5	560.0
995-999	Gifts and contributions	468.2	156.3	229.2	236.6	310.8
1-999	**Total expenditure**	**20326.9**	**5248.4**	**7839.9**	**10578.6**	**14608.2**
	Percentage distribution					
1-12	Food	16.5	26.3	24.7	21.2	18.7
20-128	Shelter	16.9	31.4	27.2	22.8	18.9
20-23	Rented living quarters	5.9	20.6	18.1	14.6	11.5
30-105	Owned living quarters	7.4	5.0	4.1	4.2	4.1
110-119	Other accommodation	.9	.3	.5	.7	.8
120-128	Water and fuel and electricity	2.7	5.5	4.6	3.3	2.6
130-197	Household operation	4.0	6.1	5.5	5.1	4.5
200-349	Household furnishings and equipment	4.3	3.8	3.7	3.7	4.2
200-230	Furniture	1.5	1.3	1.1	1.1	1.4
240-274	Household appliances	.8	.8	.9	.8	.9
280-349	Other	2.0	1.7	1.7	1.8	1.9
360-641	Clothing	6.7	5.3	6.4	6.4	6.3
650-692	Personal care	1.7	2.2	2.2	2.0	1.8
700-740	Medical and health care	1.9	2.0	2.2	2.3	2.3
750-781	Tobacco and alcoholic beverages	3.2	3.8	4.2	3.9	4.1
790-844	Transportation	11.5	5.6	9.3	10.6	12.4
790-818	Automobile and truck	9.7	3.1	6.6	8.2	10.3
790-791	Purchase	4.5			3.0	4.7
800-818	Operation	5.2	2.4	4.1	5.2	5.6
820-844	Other transportation	1.8	2.5	2.7	2.4	2.2
850-922	Recreation	4.8	4.5	3.9	4.2	4.4
930-936	Reading	.6	1.0	.8	.8	.7
940-951	Education	.7	1.2	.9	.8	.6
960-971	Miscellaneous expenses	2.2	2.3	2.0	2.1	2.6
1-971	**Total current consumption**	**74.9**	**95.3**	**93.0**	**85.9**	**81.4**
980-981	Personal taxes	18.3	1.1	2.8	8.9	12.6
985-991	Security	4.5	.7	1.2	2.9	3.8
995-999	Gifts and contributions	2.3	3.0	2.9	2.2	2.1
1-999	**Total expenditure**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Statistics Canada #62550/Vol.II (Table 1)

Résumé des dépenses des familles, selon le revenu de la famille, 16 villes, Canada, 1978

Ensemble des familles et des personnes seules

Family income - Revenu de la famille						
$16 000 - 19 999	$20 000 - 24 999	$25 000 - 29 999	$30 000 - 34 999	$35 000 and over - $35 000 et plus		
					Caractéristiques de la famille	
639	787	631	374	622	Nombre de familles dans l'échantillon	1100
437 370	522 690	423 710	269 430	435 720	Nombre estimatif de familles	1101
					Moyennes	
2 92	3 19	3 31	3 28	3 74	Taille de la famille	1102
30	29	23	18	13	Enfants de moins de 5 ans	1103
59	67	72	67	70	Enfants de 5 à 15 ans	1104
08	12	11	15	21	Adultes de 16 à 17 ans	1105
1 84	2 06	2 22	2 26	2 69	Adultes de 18 à 64 ans	1106
16	11	09	07	08	Adultes de 65 ans et plus	1107
88	1 11	1 26	1 33	1 53	Travailleurs à temps plein	1114
42 2	41 0	40 2	43 4	45 2	Age du chef	1115
17897 2	22442 3	27425 1	32154 6	46683 4	Revenu avant impôt	1116
810 9	892 1	815 1	877 9	1208 2	Autres recettes monétaires	1117
615 7	1467 3	1918 3	3591 2	6668 5	Variation nette de l'actif et du passif	1118
					Pourcentages	
48 3	60 1	69 5	78 6	86 1	Propriétaires de logement	1120
79 7	91 1	90 7	91 0	90 8	Propriétaires d'automobile ou de camion	1121
64 5	63 5	69 6	65 6	73 2	Chefs Canadiens de naissance	1127
14 2	20 4	29 9	39 1	38 3	Epouses travaillant à plein temps	1128
					Dépenses moyennes en dollars	
3272 1	3896 0	4025 6	4361 6	5407 1	Alimentation	1- 12
3235 6	3664 7	4197 5	4528 1	5431 7	Logement	20-128
1329 2	1155 8	965 2	825 4	659 6	Logement loué	20- 23
1294 3	1760 0	2353 7	2659 1	3263 0	Logement appartenant à l'occupant	30-105
125 9	168 4	231 5	287 9	590 2	Autres dépenses de logement	110-119
486 1	580 5	647 1	755 6	918 9	Eau, combustible et électricité	120-128
787 3	856 5	1000 3	1080 7	1398 0	Services ménagers	130-197
811 2	915 4	1218 2	1281 3	1732 6	Articles et accessoires d'ameublement	200-349
283 5	319 7	471 9	405 3	587 6	Meubles	200-230
165 8	185 7	224 5	256 9	315 9	Appareils ménagers	240-274
361 9	410 0	521 8	619 1	829 1	Autres	280-349
1229 6	1415 4	1830 4	1934 5	2946 4	Habillement	360-641
321 4	351 9	417 6	467 3	590 8	Soins personnels	650-692
385 9	420 7	489 0	529 2	680 1	Frais médicaux et de santé	700-740
588 0	707 0	817 0	811 2	1051 9	Tabac et alcool	750-781
2229 6	2662 7	3108 6	3286 7	4546 9	Transport	790-844
1874 0	2323 5	2736 1	2815 6	3868 8	Automobile et camion	790-818
804 8	1031 9	1270 3	1241 8	2021 1	Achat	790-791
1069 2	1291 6	1465 9	1573 8	1847 7	Utilisation	800-818
355 6	339 2	372 5	471 1	678 1	Autres	820-844
826 8	1076 0	1348 9	1397 2	2088 4	Loisirs	850-922
107 8	121 0	140 0	170 3	229 4	Lecture	930-936
105 2	135 3	209 3	197 7	359 1	Education	940-951
430 1	464 0	620 3	605 6	838 1	Dépenses diverses	960-971
14330.5	**16486.7**	**19420.7**	**20651.3**	**27300.6**	**Total, dépenses de consommation courants**	1-971
2711 3	3787 [illegible]	5078 8	6482 2	10351 3	Impôts personnels	980-981
726 9	973 3	1208 0	1369 0	2405 6	Sécurité	985-991
409 0	473 4	666 0	655 1	926 4	Dons et contributions	995-999
18177.7	**21721.1**	**26373.5**	**29157.6**	**40984.0**	**Total, dépenses**	1-999
					Répartition en pourcentage	
18 0	17 0	15 3	15 0	13 2	Alimentation	1- 12
17 8	16 9	15 9	15 5	13 3	Logement	20-128
7 3	5 3	3 7	2 8	1 6	Logement loué	20- 23
7 1	8 1	8 9	9 1	8 0	Logement appartenant à l'occupant	30-105
[illegible]	8	9	1 0	1 4	Autres dépenses de logement	110-119
2 7	2 7	2 5	2 6	2 2	Eau, combustible et électricité	120-128
4 3	3 9	3 8	3 7	3 4	Services ménagers	130-197
4 5	4 2	4 6	4 4	4 2	Articles et accessoires d'ameublement	200-349
1 6	1 5	1 8	1 4	1 4	Meubles	200-230
9	9	9	9	8	Appareils ménagers	240-274
2 0	1 9	2 0	2 1	2 0	Autres	280-349
6 8	6 5	6 9	6 8	7 2	Habillement	360-641
1 8	1 6	1 6	1 6	1 4	Soins personnels	650-692
2 1	1 9	1 9	1 8	1 7	Frais médicaux et de santé	700-740
3 2	3 3	3 1	2 8	2 6	Tabac et alcool	750-781
12 3	12 3	11 8	11 3	11 1	Transport	790-844
10 3	10 7	10 4	9 7	9 4	Automobile et camion	790-818
4 4	4 8	4 8	4 3	4 9	Achat	790-791
5 9	5 9	5 6	5 4	4 5	Utilisation	800-818
2 0	1 6	1 4	1 6	1 7	Autres	820-844
4 5	5 0	5 1	4 8	5 1	Loisirs	850-922
6	6	5	6	6	Lecture	930-936
6	6	6	7	9	Education	940-951
2 4	2 1	2 4	2 1	2 0	Dépenses diverses	960-971
78.8	**75.9**	**73.6**	**70.8**	**66.6**	**Total, dépenses de consommation courants**	1-971
14 9	17 4	19 3	22 2	25 3	Impôts personnels	980-981
4 0	4 5	4 6	4 7	5 9	Sécurité	985-991
2 3	2 2	2 5	2 2	2 3	Dons et contributions	995-999
100.0	**100.0**	**100.0**	**100.0**	**100.0**	**Total, dépenses**	1-999

APPENDIX E.2

CONSUMER PRICE INDEXES FOR CANADA, MAJOR COMPONENTS, SELECTED SUB-GROUPS AND SPECIAL AGGREGATES (Not Seasonally Adjusted), 1981 =100

Major components, selected sub-groups and special aggregates Composantes principales, certains sous-groupes et agrégats spéciaux	Indexes Indices			Percentage change - May 1983 from Taux de variation - Mai 1983 contre	
	May 1983 Mai 1983	April 1983 Avril 1983	May 1982 Mai 1982	April 1983 Avril 1983	May 1982 Mai 1982
ALL-ITEMS - ENSEMBLE	116.1	115.8	110.1	0.3	5.4
Major Components and selected sub-groups - Composantes principales et certains sous-groupes					
Food - Aliments	111.8	110.0	107.5	1.6	4.0
Food purchased from stores - Aliments achetés au magasin	110.6	108.3	107.4	2.1	3.0
Meat, Poultry and Fish - Viande, volaille et poisson	107.9	106.1	105.8	1.7	2.0
Meat - Viande	108.2	105.8	106.8	2.3	1.3
Beef - Boeuf	104.9	100.0	104.5	4.9	0.4
Pork - Porc	116.2	116.5	113.5	- 0.3	2.4
Other Meat - Autre viande	107.6	108.3	105.0	- 0.6	2.5
Poultry - Volaille	104.3	104.1	101.7	0.2	2.6
Fish - Poisson	115.2	115.0	109.3	0.2	5.4
Dairy products and eggs - Produits laitiers et oeufs	112.8	113.1	108.7	- 0.3	3.8
Dairy products - Produits laitiers	114.2	114.7	110.1	- 0.4	3.7
Fresh fluid milk - Lait entier frais	109.1	110.4	109.7	- 1.2	- 0.5
Eggs - Oeufs	100.2	99.5	97.7	0.7	2.6
Cereal and bakery products - Produits céréaliers et de boulangerie	110.6	108.5	106.1	1.9	4.2
Cereal products - Produits céréaliers	112.2	111.1	107.9	1.0	4.0
Bakery products - Produits de boulangerie	110.1	107.6	105.4	2.3	4.5
Bread - Pain	109.7	106.4	105.7	3.1	3.8
Fruit and vegetables - Fruits et légumes	115.7	109.1	111.6	6.0	3.7
Fresh fruit - Fruits frais	120.1	113.3	123.9	6.0	- 3.1
Processed fruit - Fruits traités	113.0	112.9	111.7	0.1	1.2
Fresh vegetables - Légumes frais	111.2	98.1	99.1	13.4	12.2
Processed vegetables - Légumes traités	122.9	123.1	116.8	- 0.2	5.2
Sugar and confections - Sucre et confiserie	92.7	87.9	92.6	5.5	0.1
Coffee and Tea - Café et thé	97.4	97.8	100.3	- 0.4	- 2.9
Fats and oils - Huiles et corps gras	106.4	105.7	102.8	0.7	3.5
Prepared and partially prepared main dishes - Mets préparés et partiellement préparés	118.3	116.8	111.6	1.3	6.0
Other food purchased from stores - Autres aliments achetés au magasin	114.0	112.5	110.4	1.3	3.3
Food purchased from restaurants - Aliments achetés au restaurant	115.9	115.3	108.3	0.5	7.0

Source: Statistics Canada #62-001/May 1983 (Table 3)

TABLEAU 3. Indices des prix à la consommation pour le Canada, composantes principales, certains sous-groupes et agrégats spéciaux (non désaisonnalisés), 1981=100

Major components, selected sub-groups and special aggregates Composantes principales, certains sous-groupes et agrégats spéciaux	Indexes Indices			Percentage change - May 1983 from Taux de variation - Mai 1983 contre	
	May 1983 Mai 1983	April 1983 Avril 1983	May 1982 Mai 1982	April 1983 Avril 1983	May 1982 Mai 1982
Housing - Habitation	119.3	119.3	111.2	0.0	7.3
Shelter - Logement	118.7	118.5	110.4	0.2	7.5
Rented Accommodation - Logement en location	115.7	115.6	108.8	0.1	6.3
Rent - Loyer	115.7	115.5	106.9	0.2	8.2
Owned Accommodation - Logement en propriété	120.0	119.8	112.3	0.2	6.8
Mortgage interest cost - Coût d'intérêts hypothécaire	133.1	132.9	120.7	0.2	10.3
Replacement cost - Coût de remplacement	101.5	101.2	102.7	0.3	- 1.2
Household operation - Dépenses de ménage	124.6	124.3	115.0	0.2	8.3
Water, fuel and electricity - Eau, combustible et électricité	129.8	129.7	117.2	0.1	10.8
Fuel oil and other liquid fuel - Mazout et autres combustibles liquides	136.3	136.3	120.8	0.0	12.8
Piped and bottled gas - Gaz naturel et gaz propane	136.0	135.9	123.5	0.1	10.1
Electricity - Electricité	120.9	120.9	111.0	0.0	8.9
Communications	125.8	125.6	118.8	0.2	5.9
Telephone service - Services téléphoniques	117.2	116.9	110.9	0.3	5.7
Household cleaning supplies - Produits d'entretien ménager	121.2	120.2	116.3	0.8	4.2
Paper, foil and plastic supplies - Articles en papier, en papier d'aluminium et en plastique	116.7	115.4	107.6	1.1	8.5
Household furnishings, equipment and related services - Articles d'ameublement, accessoires et services connexes	112.4	113.6	107.8	- 1.1	4.3
Furniture - Meubles	109.4	112.3	107.5	- 2.6	1.8
Major household appliances - Gros appareils ménagers	114.8	116.5	108.6	- 1.5	5.7
Clothing - Habillement	110.1	110.0	105.4	0.1	4.5
Women's wear - Vêtements pour femmes	108.6	108.8	104.3	- 0.2	4.1
Girls' wear - Vêtements pour filles	109.8	109.8	105.0	0.0	4.6
Men's wear - Vêtements pour hommes	109.9	109.8	105.5	0.1	4.2
Boys' wear - Vêtements pour garçons	110.7	110.5	106.2	0.2	4.2
Clothing materials and related services - Tissus pour vêtements et services connexes	116.3	115.4	109.2	0.8	6.5
Transportation - Transports	115.3	116.8	113.8	- 1.3	1.3
Private transportation - Transport privé	113.7	115.9	112.9	- 1.9	0.7
Automobile and truck purchase - Achat d'automobiles et de camions	108.1	107.7	104.0	0.4	3.9
Automobile and truck operation - Utilisation d'automobiles et de camions	117.6	121.9	119.6	- 3.5	- 1.7
Gasoline - Essence	112.1	120.6	121.1	- 7.0	- 7.4
Automobile and truck repairs - Réparations d'automobiles et de camions	117.4	117.3	110.9	0.1	5.9
Vehicle insurance premiums - Primes d'assurance-automobile	132.4	132.6	127.5	- 0.2	3.8
Public transportation - Transport public	127.2	123.6	120.7	2.9	5.4
Local and commuter transportation services - Transport local et de banlieue	121.2	121.4	114.7	- 0.2	5.7
Inter-city transportation services - Transport interurbain	131.0	125.0	124.5	4.8	5.2

TABLE 3. Consumer Price Indexes for Canada, Major Components, Selected Sub-groups and Special Aggregates (Not Seasonally Adjusted), 1981=100

TABLEAU 3. Indices des prix à la consommation pour le Canada, composantes principales, certains sous-groupes et agrégats spéciaux (non désaisonnalisés), 1981=100

Major components, selected sub-groups and special aggregates Composantes principales, certains sous-groupes et agrégats spéciaux	Indexes Indices			Percentage change - May 1983 from Taux de variation - Mai 1983 contre	
	May 1983 Mai 1983	April 1983 Avril 1983	May 1982 Mai 1982	April 1983 Avril 1983	May 1982 Mai 1982
Health and personal care - Santé et soins personnels	118.2	117.7	110.2	0.4	7.3
Health care - Soins de santé	121.3	121.2	111.5	0.1	8.8
Personal care - Soins personnels	115.8	115.1	108.9	0.6	6.3
Recreation, reading and education - Loisirs, lecture et formation	114.9	114.1	107.7	0.7	6.7
Recreation - Loisirs	113.1	112.1	106.9	0.9	5.8
Home entertainment equipment - Matériel de loisirs à la maison	106.9	106.9	105.0	0.0	1.8
Home recreation equipment - Matériel de loisirs d'intérieur	112.6	112.0	106.3	0.5	5.9
Outdoor recreation equipment - Matériel de loisirs d'extérieur	114.7	111.4	108.6	3.0	5.6
Reading and education - Lecture et formation	122.0	121.8	110.3	0.2	10.6
Reading - Lecture	124.0	123.6	112.9	0.3	9.8
Education - Formation	120.0	119.9	107.7	0.1	11.4
Tobacco and alcohol - Tabacs et boissons alcoolisées	128.1	125.6	112.9	2.0	13.5
Tobacco products and smokers' supplies - Produits du tabac et articles pour fumeurs	134.0	127.8	110.4	4.9	21.4
Alcoholic beverages - Boissons alcoolisées	125.3	124.6	114.1	0.6	9.8
Reclassified by goods and services - Reclassé par biens et services:					
Goods - Biens	114.1	113.8	109.2	0.3	4.5
Durable goods - Biens durables	109.2	109.1	105.3	0.1	3.7
Semi-durable goods - Biens semi-durables	111.4	111.3	106.3	0.1	4.8
Non-durable goods - Biens non-durables	116.8	116.3	111.5	0.4	4.8
Non-durable goods excluding food - Biens non-durables sans les aliments	122.4	123.7	115.5	- 1.0	6.1
Goods excluding food - Biens sans les aliments	115.6	116.1	111.1	- 0.4	4.0
Services	119.3	118.8	111.4	0.4	7.1
Services excluding shelter - Services sans le logement	119.8	119.1	112.4	0.6	6.6
Selected special aggregates - Certains agrégats spéciaux:					
All-items excluding food - Ensemble sans les aliments	117.4	117.5	110.8	- 0.1	5.9
Energy - Energie	120.8	125.1	119.3	- 3.4	1.3
All-items excluding energy - Ensemble sans l'énergie	115.6	114.8	109.1	0.7	6.0
Food and energy - Aliments et l'énergie	114.3	114.2	110.8	0.1	3.2
All-items excluding food and energy - Ensemble sans les aliments et l'énergie	116.9	116.4	109.8	0.4	6.5
All-items excluding housing - Ensemble sans l'habitation	114.6	114.0	109.5	0.5	4.7
All-items excluding shelter - Ensemble sans le logement	115.6	115.2	110.1	0.3	5.0

APPENDIX F

APPENDIX F.1

AVERAGE VEHICLE TRIPS AND VEHICLE km PER HOUSEHOLD
AND AVERAGE TRIP LENGTH BY NUMBER OF PERSONS IN HOUSEHOLD

NUMBER OF PERSONS IN HOUSEHOLD	DISTRIBUTION OF HOUSEHOLDS	TRIP RATE PER HOUSEHOLD		VEHICLE km PER HOUSEHOLD		AVERAGE TRIP LENGTH (km)
		Annual	Daily	Annual	Daily	
One	21.5	544	1.5	7115	19.5	13.2
Two	30.4	1220	3.3	17263	47.3	14.3
Three	17.3	1735	4.8	23730	65.0	13.8
Four	16.2	2022	5.5	26178	71.8	13.0
Five or more	14.6	2244	6.1	29047	79.6	13.0
All Households	100.0*	1443	4.0	19364	53.1	13.4

APPENDIX F.2

AVERAGE VEHICLE TRIPS AND VEHICLE km PER HOUSEHOLD
AND AVERAGE TRIP LENGTH BY NUMBER OF EMPLOYED PERSONS IN HOUSEHOLD

NUMBER OF EMPLOYED PERSONS IN HOUSEHOLD	DISTRIBUTION OF HOUSEHOLDS	TRIP RATE PER HOUSEHOLD		VEHICLE km PER HOUSEHOLD		AVERAGE TRIP LENGTH (km)
		Annual	Daily	Annual	Daily	
None	28.5**	557	1.5	6727	18.5	12.1
One	45.3	1440	4.0	19921	54.5	13.8
Two	22.4	2216	6.1	29911	81.9	13.5
Three	3.1	3398	9.3	41726	119.9	12.9
Four or more	0.7	4329	11.9	52561	144.0	12.2
All Households	100.0*	1443	4.0	19364	53.1	13.4

* Total number of households = 75,412,000

** Includes households with persons who are unemployed, retired, or not in the labor force.

Source : 1977 NPTS
89 "Household Travel" Tab 4.5.6.3

APPENDIX F.3

AVERAGE VEHICLE TRIPS AND VEHICLE km PER HOUSEHOLD
AND AVERAGE TRIP LENGTH BY NUMBER OF LICENSED DRIVERS IN HOUSEHOLD

NUMBER OF LICENSED DRIVERS IN HOUSEHOLD	DISTRIBUTION OF HOUSEHOLDS*	TRIP RATE PER HOUSEHOLD		VEHICLE km PER HOUSEHOLD		AVERAGE TRIP LENGTH (km)
		Annual	Daily	Annual	Daily	
One	33.6	910	2.5	11889	32.5	13.0
Two	42.8	1836	5.0	25070	68.7	13.7
Three	8.2	2926	8.0	38895	106.5	13.4
Four or more	2.7	4131	11.3	53718	147.2	13.0
Households with Drivers	87.3	1649	4.5	22101	60.5	13.4
All Households	100.0**	1443	4.0	19364	53.1	13.4

*Excludes 12.7 percent of households that do not have a licensed driver.

**Total number of households = 75,412,000

APPENDIX F.4

AVERAGE VEHICLE TRIPS AND VEHICLE km PER HOUSEHOLD
AND AVERAGE TRIP LENGTH BY NUMBER OF VEHICLES IN HOUSEHOLD

NUMBER OF VEHICLES IN HOUSEHOLD	DISTRIBUTION OF HOUSEHOLDS	TRIP RATE PER HOUSEHOLD		VEHICLE km PER HOUSEHOLD		AVERAGE TRIP LENGTH (km)
		Annual	Daily	Annual	Daily	
None	15.3	38	0.1	507	1.4	13.2
One	34.6	1059	2.9	12985	35.6	12.2
Two	34.4	1892	5.2	25726	70.5	13.7
Three	10.7	2509	6.9	36014	98.6	14.3
Four or more	5.0	3030	8.3	41828	114.6	13.8
Vehicle-owning Households	84.7	1697	4.6	22771	62.4	13.4
All Households	100.0*	1443	4.0	19364	53.1	13.4

* Total number of households = 75,412,000

APPENDIX G.1

TRADITIONAL FAMILY LIFE CYCLES: SELECTED FAMILY CHARACTERISTICS

	Life Cycle Stage[2/]											
	1	2	3	4	5	6	7	8	9	10	11	12
Residence												
Percent Urban	83	73	67	66	63	61	62	68	68	63	73	73
Percent Single-Family Detached Dwelling	20	48	65	69	78	83	88	86	79	80	54	57
Economic and Demographic Characteristics												
Median Family Income Range ($000)	7.5 to 9.9	12.0 to 14.9	12.0 to 14.9	12.0 to 14.9	15.0 to 19.9	15.0 to 19.9	15.0 to 19.9	15.0 to 19.9	15.0 to 19.9	10.0 to 11.9	3.0 to 3.9	3.0 to 3.9
Avg. # of Persons	1.0	2.0	3.3	3.9	4.2	4.4	4.5	4.5	2.0	2.0	1.0	1.0
Avg. # of Children	NA	NA	1.3	1.9	2.2	2.4	2.5	2.5	NA	NA	NA	NA
Head of Household												
Avg. Age (Yrs.)	24	25	28	31	34	41	46	50	55	64	74	84
Percent Female 3/	39	NA	NA	NA	NA	NA	NA	NA	NA	NA	80	71
Percent Employed	80	89	89	85	87	85	84	78	82	41	7	5
Spouse of Head[3/]												
Avg. Age (Yrs.)	NA	23	25	28	32	38	43	47	53	61	NA	NA
Percent Employed	NA	69	29	29	34	39	45	41	40	23	NA	NA
Transportation Resources												
Avg. # of Vehicles	1.0	1.8	1.7	1.8	1.9	2.0	2.5	2.9	1.9	1.6	0.5	0.3
Avg. # of Drivers	0.9	1.8	1.8	1.8	1.8	1.8	2.5	2.9	1.7	1.6	0.5	0.3
Percent Within ¼ Mile of Public Transit	50	36	29	30	28	24	25	31	30	32	40	41

1/Based on 9,206 families in 1977 NPTS.

2/Refer to Table 1 for definition of stages in the traditional family life cycle.

3/In husband/wife households, only those cases were used where the husband was designated as head of household.

Source : 1977 NPTS
#7 "A Life Cycle of Travel by the American Family"
(Table 5)

APPENDIX G.2

AVERAGE VEHICLE TRIPS AND VEHICLE km PER HOUSEHOLD AND AVERAGE TRIP LENGTH BY HOUSEHOLD STRUCTURE

HOUSEHOLD STRUCTURE	DISTRIBUTION OF HOUSEHOLDS	TRIP RATE PER HOUSEHOLD		VEHICLE km PER HOUSEHOLD		AVERAGE TRIP LENGTH (km)
		Annual	Daily	Annual	Daily	
Single adult, no children	18.0	585	1.6	7854	21.5	13.4
Two or more adults, no children	22.4	1469	4.0	21612	59.2	14.6
Single adult, youngest child under 6	1.9	684	1.9	7134	19.5	10.3
Two or more adults, youngest child under 6	15.5	1834	5.0	24737	67.8	13.5
Single adult, youngest child 6-15	3.7	1131	3.1	11514	31.5	10.0
Two or more adults, youngest child 6-15	18.0	2293	6.3	29908	81.9	13.0
Single adult, youngest child 16 or older	2.2	1115	3.1	13203	36.2	11.7
Two or more adults, youngest child 16 or older	6.8	2334	6.4	32492	89.0	13.8
Single adult, retired, no children	3.5	330	0.9	3102	8.5	9.3
Two or more adults, retired, no children	8.0	758	2.1	9199	25.2	12.2
All Households	100.0*	1443	4.0	19364	53.0	13.4

*Total number of households = 75,412,000

Source : 1977 NPTS
#9 "Household Travel"

APPENDIX H

SHARED VEHICLE FLEET CONCEPTS

- Related Terminology --

* SHARED VEHICLE FLEETS
* SHARED CAR (or AUTOMOBILE) FLEETS
* SHARED CAR OWNERSHIP
* MULTIPLE SHARED CAR OWNERSHIP
* VEHICLE SHARING SCHEMES
* MULTI-USER VEHICLE SYSTEMS
* PUBLIC AUTOMOBILE SYSTEMS
* PUBLICARS
* LICENCED CAR CO-OPERATIVE SOCIETY
* NEIGHBOURHOOD CARS (or CO-OPERATIVES)
* MOBILITY ENTERPRISE
* COMMUNITY TRANSPORT CENTRE
* MOTOR POOLS
* SELF-DRIVE TAXI
* CAR RENTAL CONCEPTS (or SHORT TERM RENTAL)
* GROUP-SHARED CAR RENTAL
* PARATRANSIT (joint ownership only)
* CAR/VAN/BUS POOLS (joint ownership only)

APPENDIX I

R E F E R E N C E S

- A Partial Listing -

1. AUTO RESTRICTED ZONE/MULTI-USER VEHICLE SYSTEM STUDY (Vol.II)
W. S. Herald/Alan M. Voorhees and Associates Inc., UMTA/U.S. DOT, Dec. 19[illegible].

2. PARATRANSIT INTERNATIONAL: OVERVIEW AND COMMENTARY ON EUROPEAN EXPERIENCE, TRENDS AND PROSPECTS
F. E. K. Britton, EcoPlan International, Paris, May 1979.

3. URBAN MOVEMENT EXPERIMENT - THE STATE-OF-THE-ART
M. Lincourt et al, Transportation Development Agency, August 1974.

4. WITKAR: AMSTERDAM'S SELF-DRIVE HIRE CITY CAR
T. Bendixson & M. G. Richards/Alan M. Voorhees and Associates Ltd., Transportation 5(1976) 63-72/Elsevier, 1976.

5. GREEN CARS - A Brief Guide to Shared Car Ownership
S. Cousins/The Open University, Milton Keynes/U.K.

6. SAMBIL - Dela bil som vi!
H. Nerman & C. Sjödell, Västerås SAMBIL Användare, 1982.

7. HYRBILSYSTEM OCH ANDRA FORMER AV MELLANTRAFIK
K. Dahlström, Arkitektursektionen vid Lunds Universitet, 1981.

8. THE MOBILITY ENTERPRISE - IMPROVING AUTO PRODUCTIVITY
F. T. Sparrow et al/Automotive Transportation Center, Purdue University, TRB/January 1982.

9. MOBILITY ENTERPRISE - ONE YEAR LATER
M. J. Doherty & F. T. Sparrow/Automotive Transportation Center, Purdue University, TRB/January 1983.

10. STAR PROGRAM - FEASIBILITY STUDY (EXECUTIVE SUMMARY)
J. Crain/Crain & Associates Inc., CALTRANS & UMTA, November 1982.

11. RESTRUCTURING THE FORM OF CAR OWNERSHIP
L. Fishman/University of Keele & J. S. Wabe/University of Warwick, July 1969.

12. RESTRUCTURING CAR OWNERSHIP
T. M. Pharoah/Dept. of Town Planning, Polytechnic of the South Bank, February 1979.

13. THE INNOVATIVE USE OF THE COMMUTER CAR
P. Amos/R. Travers Morgan Pty. Ltd. & P. Skene/Department of Transport, South Australia, March 1982.

14. FREE ENTERPRISE URBAN TRANSPORTATION
G. Roth & G. C. Wynne/IBRD, Council for International Urban Liaison, 1982.

15. PARATRANSIT FORSKNING KRING NYA TRAFIKFORMER
Transportforskningsdelegationen, Stockholm, March 1983.

16. RURAL TRANSPORT EXPERIMENTS: SOUTH EXMOOR CAR SERVICE

17. THE FUTURE ROLE OF THE AUTOMOBILE IN CANADA
A. M. Khan/Carleton University, Strategic Planning/Transport Canada, Mar/1982.

18. NEW APPROACHES TO UNDERSTANDING TRAVEL BEHAVIOUR
P. M. Allaman et al/Charles River Associates Inc., NCHRP Report 250, September 1982.

19. LIFE CYCLE AND HOUSEHOLD TIME-SPACE PATHS: EMPIRICAL INVESTIGATION
L. P. Kostyniuk/University of Michigan & R. Kitamura/University of California, TRB, January 1982.

20. THE ANALYSIS OF DAILY TRAVEL/ACTIVITY BEHAVIOUR: METHODOLOGY & APPLICATION
E. I. Pas, Duke University, TRB, January 1982.

21. THE ROLE OF WOMEN IN FAMILY TRANSPORTATION BEHAVIOUR
T. Bayes et al/University of Kentucky, UMTA/U.S. DOT, March 1982.

22. 1977 NATIONWIDE PERSONAL TRANSPORTATION STUDY (Final Reports)
Comsis Corporation & Highway Statistics Div./FHWA, U.S. DOT, 1980-1982.

23. TRAVEL TO WORK SURVEY: 1973-1981
N. Goudreault/University of Sherbrooke, TC & EMR, July 1982.

24. CANADIAN TRAVEL SURVEY - Canadians Travelling in Canada
Statistics Canada, April 1982.

25. GUIDES FOR FAMILY BUDGETING 1983
J. Patterson et al, Social Planning Council of Metropolitan Toronto, Jan 1983.

26. PERSONAL TRAVEL AND TRANSPORTATION EXPENDITURES IN CANADA
R. Daigle/Research Branch, Canadian Transport Commission, August 1978.

27. ANALYSIS OF THE EFFECTS OF GASOLINE PRICES AND VEHICLE DESIGN ATTRIBUTES ON CONSUMER CHOICE OF VEHICLE TYPE
L. Sherman & C. F. Manski/Cambridge Systematics, Inc., TRB, January 1982.

28. COST OF OWNING AND OPERATING AUTOMOBILES AND VANS 1982
Federal Highway Administration/U.S. DOT.

29. THE FUTURE OF THE USE OF THE CAR
55th, 56th and 57th Round Tables on Transport Economics, European Conference of Ministers of Transport, April-October 1981.

30. MICROCOMPUTER APPLICATIONS IN THE MANAGEMENT OF PARATRANSIT OPERATIONS
R. V. Giangrande & L. J. Harman/TSC, U.S. DOT, September 1981.

31. INNOVATIVE USES OF SMALL VEHICLES IN OTHER COUNTRIES FOR PUBLIC AND PRIVATE OPERATORS
J. Yu, UMTA/U.S. DOT, TRB January 1982.

32. AN EMERGING PUBLIC/PRIVATE PARTNERSHIP IN URBAN TRANSPORTATION
M.D. Meyer & S. Gordon, Massachusetts Institute of Technology, TRB January 1982.

33. TRANSPORTATION IN TRANSITION
M. Pikarsky/IIT Research Institute, Illinois Institute of Technology, March 1982.

CA1
DTC 820
83
S38
C.2

Library and Information Centre / Centre de documentation (LSLA)
RECEIVED - REÇU LE
SEP 16 1983
Transport Canada / Transports Canada

Performing Organization Name and Address
Jouko A. Parviainen & Associates
1125 Linbrook Road
Oakville, Ontario
Canada L6J 2L3